

CHAPTER 6

SAMPLE MAINTENANCE PRACTICES

Seven maintenance practices were developed from applying the guidance offered in this Guidebook. Topics were selected to appeal to a wide range of agencies operating small, “cutaway”-type automotive vans to full-size transit buses. The practices illustrate how the guidance is applied and offers agencies seven actual practices that they can use as is or modify to suit their particular needs and local operating conditions. Four members of the research team, each with varying degrees of computer and writing skills, developed the practices. Although the sample practices were proofread for grammar and accuracy, each reflects the writing style and approach of the individual author.

The sample practices were all developed in cooperation with transit agencies based on their local conditions. Lessons learned from developing these practices were then used to fine-tune Guidebook material. In some cases, the finished practice builds upon an existing agency practice

and enhances it with additional detail offered by the Guidebook, such as the use of photos, additional safety information, and more descriptive step-by-step work procedures. In other cases, the practices were developed to fill a void in the agency’s existing library of practices. For example, the Potomac and Rappahannock Transportation Commission (PRTC) recently took delivery of Gillig buses with an AC system new to their operation. The AC PMI practice was developed specifically for their new AC/bus combination.

Each practice follows the format presented in Chapter 4 of the Guidebook. Some were developed using the MS Word template, while others were created without the template. Practice titles are based on the classification system used to post practices on the Web Board as defined in Chapter 5. Table 6-1 summarizes the seven sample practices included in this chapter.

TABLE 6-1 Summary of sample practices

Practice Title	Purpose	Cooperating Agency and Reference Material	Notes
#1 - Bus PMI; 1990 GMC/RTS/NOVA, 40-foot high floor	Provides instructions for conducting a PMI on a full-size bus	- MTA New York City Transit (MTA NYCT) - GMC/RTS/NOVA	- Guidebook format was used to create an introduction to the PMI checklist - Checklist format is based on MTA NYCT inspection sheet, which is extremely thorough - Includes body diagram for noting defects
#2 - Bus PMI; 2003 STARTRANS Senator, 20-Ft.; Ford E-350 Chassis	Provides instructions for conducting a PMI on an automotive-based “cutaway”-style bus	- RADAR, Unified Human Services Transportation Inc., Roanoke, VA - Supreme - Ford Motor Company - Haynes	- Word template format was used to create an introduction to the PMI checklist - Practice is of particular interest to smaller agencies operating this popular Ford chassis
#3 - Component PMI; Thermo King Model T11-M85 AC with IntelligAIRE II; 2004, Gillig, 30-foot low floor	Provides instructions for conducting an air conditioning system PMI on a full-size bus	- Potomac and Rappahannock Transportation Commission (PRTC) - Thermo King Corporation	- Applicable to large buses with a similar AC system - Serves as a framework for developing HVAC PMI on other buses - Section added that lists additional AC reference material available to technicians if needed
#4 - Electrical; Repair; All buses	Provides an introduction to electrical circuit failures, meter usage, and repair	- PRTC - Thermo King Corporation - TMC RP 129	- Applicable to all buses - Includes general electrical troubleshooting, wire repairs, and use of multi-meters - Prohibits use of jumpers and test lamps

TABLE 6-1 (Continued) Summary of sample practices

Practice Title	Purpose	Cooperating Agency and Reference Material	Notes
#5 - Brakes; Remove and Replace Front Brakes; 2003 STARTRANS Senator, 20-Ft.; Ford E-350 Chassis	Provides instructions for the proper removal and replacement of front brake pads on a cutaway-style bus	- RADAR, Unified Human Services Transportation Inc., Roanoke, VA - Supreme - Ford Motor Company - Haynes	- Word template format was used to create the entire practice - Practice is of particular interest to smaller agencies operating this popular Ford chassis
#6 - Body; Door Adjustment; Vapor/NFIL Slide Glide Door; 2002 New Flyer, 40LF	Provides instructions for the proper adjustment of front or rear slide glide style doors on a full-size bus	- SEPTA - New Flyer Industries, Ltd.	- Applies to front and rear door adjustments - Can be adapted to other buses with similar door style - Includes adjustment of door operating speeds
#7 – Service; Service Line Functions	Defines the duties for daily service line operations, including fueling, cleaning, and critical mechanical checks	- Lynx, Orlando, FL	- Can be applied to any service line operation - Includes daily servicing and cleaning functions - Also includes detailed cleaning functions

SAMPLE MAINTENANCE PRACTICE #1

Title

Bus PMI; 1990 GMC/RTS/NOVA, 40-Ft High Floor

Agency Name

This sample practice is based on a General Inspection Sheet provided by MTA New York City Transit (MTA NYCT) and enhanced to add information on the oil/filter change process, safety precautions, instructions for using the Inspection Sheet, and other items.

Date

February 7, 2005 (Original Issue)

Legal Disclaimer/Source

The following disclaimer is used when this practice is posted on the TRB Maintenance Practices Web Board; remove for internal agency use:

The information contained in the published content is provided as a service to the bus transit community, and does not constitute advice. Every attempt was made to provide quality information for the purposes outlined for this project, but we make no claims, promises, or guarantees about the accuracy, completeness, or adequacy of the content. Maintenance advice must be tailored to the specific circumstances of each agency. Because bus maintenance practices can change without notice, nothing provided herein should be used as a substitute for the advice of competent mechanics and/or maintenance crews.

Purpose

This maintenance practice provides instructions for conducting a PMI on a GMC/RTS/NOVA full-size, 40-foot bus.

Glossary of Terms/Abbreviations

The following abbreviations are used on the attached PMI Sheet:

- NG: Not Good. The criteria listed for a given inspection have not been met.
- S/W: Steering Wheel
- ABS: Antilock Braking System
- psi: pounds per square inch (pressure)
- Min.: Minimum

Summary of Local Conditions

- The procedures used in this practice are based on using an in-ground bus lift.
- Inspections are done at 4,000- to 6,000-mile intervals depending on bus duty cycle.
- PMIs for HVAC and wheelchair lifts are covered by other agency practices.

Parts

Engine Oil Filter (see Parts clerk for appropriate part number).

Time Standard

Not applicable.

Special Tools

Manometer

Pro-Link Engine Diagnostic Tool

Tire Pressure Gauge

Battery Tester

Torque Wrench

Safety Precautions/Applicable Regulations

- Wear eye and hand protection.
- Pressurized lines should not be disconnected until the pressure is safely and controllably released.
- Attach exhaust hose to bus exhaust pipe outlet.
- Always use Safety Stands to support a lifted vehicle.
- When addressing the air pressure system, note that a malfunctioning pressure relief valve may not relieve pump pressure and that closing the shutoff valve may cause severe pump damage or high-pressure hoses to rupture. Constantly observe the pressure gauge while closing the shut-off valve. If pressure rises rapidly or appears to be uncontrolled, do *not* completely close the valve before inspecting the pump and pump relief valve.
- Be careful when opening the filler cap for the coolant. Release slowly and make sure to bleed off all pressure. The sudden release of pressure from a heated coolant system can result in a loss of coolant and possible injury (i.e., scalding) from the hot fluid.
- This practice complies with United States Department of Transportation (USDOT) requirements under CFR 49 Part 393 and CFR 49 Part 396.

Hazardous Materials

Waste oil and filters are considered hazardous waste and must be disposed of in containers set aside for them; check with your Supervisor if you are not sure of their location. Wear latex gloves when handling waste oil and filters.

Step-by-Step Procedures – Bus Preventive Maintenance Inspection

The mechanic carrying out the inspection will use the attached PMI Sheet as follows:

1. Complete the top part of the sheet, including bus number, hub mileage, garage, and inspection start date.
2. Also note the type of inspection being performed (i.e., “A” level, “B” level, or “C” level). (Note: This sample practice is for a basic “A” level inspection, where the engine oil and filters are changed every 4,000 to 6,000 miles depending on the








duty cycle. Additional inspection activities, such as fuel and air filter changes, are performed at different inspection intervals.)

3. Sign your name and enter your badge (employee) number. Also have your helper sign their name and enter their badge (employee) number.
4. Make sure that the engine compartment and bus undercarriage have been steam cleaned at least 12 hours before the inspection begins.
5. Make sure that the bus is brought into the inspection area for the actual inspection.
6. Inspection steps listed on the attached Preventive Maintenance Sheets must be followed in the order shown. All the items listed in the Sheet must be inspected.
7. The **Action Items** listed on the Sheet in each category must be undertaken before the actual inspection occurs.
8. The **Criteria listed** for each **Performance Check** must be closely followed.
9. Where the performance for the particular check is acceptable, it should be noted on the form as “OK” by checking-off the associated box. If it is not acceptable, it should be noted on the form as “NG” and the appropriate box checked-off.
10. For those items found to be outside acceptable performance, a description of the defect or unacceptable performance should be noted on the attached Defect Description Sheet.
11. A separate form containing a Bus Diagram Sheet is available to indicate all body damage.
12. The completed Preventive Maintenance Inspection Sheets along with the Defect Description Sheet and the marked-up copy of the Bus Diagram Sheet is then submitted to your Supervisor for their review and approval. Be sure to have your Supervisor sign their name and enter their badge (employee) number.



PREVENTIVE MAINTENANCE INSPECTION - SHEET 1

INSPECTION TYPE A B C				Signature	Employee No.
Bus Number		Garage		Inspector	
Hub Mileage		Date		Helper	
				Supervisor	
Beginning Checks					
Action Items: <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div> <div> Hook up manometer to check air-intake vacuum restriction. Clear work area in rear of bus to check speedometer and parking brake. Turn master switch to "Run". Listen for ABS valve bursts. Start engine. Reverse bus. Move forward, check speedometer. Align bus in work area for lifting. Confirm exhaust hose is in place. </div> </div>					
Performance Checks:		Check Criteria:	OK	NG	
1. ABS/Traction Control Valves		Total of four air bursts should be heard	<input type="checkbox"/>	<input type="checkbox"/>	
2. Back-Up Alarm		Must be audible from driver's seating area	<input type="checkbox"/>	<input type="checkbox"/>	
3. Speedometer Operation		Must register vehicle speed	<input type="checkbox"/>	<input type="checkbox"/>	
4. Parking Brake Operation		Bus does not move OR bus stops upon application	<input type="checkbox"/>	<input type="checkbox"/>	
Engine Diagnostics/Miscellaneous					
Action Items: <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <input type="checkbox"/> </div> <div> Hook-Up Engine Diagnostics. Print out fault codes. Attach to inspection sheet. Clear all inactive codes. Take following engine performance readings: </div> </div>					
Performance Checks:		Check Criteria:	OK	NG	
5. Engine Oil Pressure (psi)		IDLE: _____ (25-45) TOP RPM: _____ (40-64)	<input type="checkbox"/>	<input type="checkbox"/>	
6. Engine Speed (rpm)		IDLE: _____ (800+/-50) FAST: _____ (1000+/-50) TOP RPM: _____ (2150+/-50)	<input type="checkbox"/>	<input type="checkbox"/>	
7. Air Intake Restriction (in H ₂ O)		Must be less than 7" H ₂ O at top RPM	<input type="checkbox"/>	<input type="checkbox"/>	
8. Fuel Pressure		IDLE: 25 TO 30 psi: TOP RPM 70 TO 90 psi	<input type="checkbox"/>	<input type="checkbox"/>	
9. Transmission Fluid Level		Level OK for Cold & Hot running conditions (Non-Sealed Sticks)	<input type="checkbox"/>	<input type="checkbox"/>	
10. Hydraulic Filtration Pressure (psi)		Must be less than 25 psi (or within green zone in dial)	<input type="checkbox"/>	<input type="checkbox"/>	
11. Anti-Freeze Protection Level		Should be in range of -34° +/- 10° F	<input type="checkbox"/>	<input type="checkbox"/>	
Drivability Function Checks (Engine Running)					
Action Items: <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <input type="checkbox"/> </div> <div> Release Parking Brake. Deplete Air System until Parking Brake Button Pops Up </div> </div>					
Performance Checks:		Check Criteria:	OK	NG	
12. Low Air Alarm Trigger		Audible and visual low air indicator below 70 psi	<input type="checkbox"/>	<input type="checkbox"/>	
13. Parking Brake Safety Pop-Up		Engages at 30 to 40 psi, if applicable	<input type="checkbox"/>	<input type="checkbox"/>	
14. Air System Re-Charge Time		Must be less than 4 minutes	<input type="checkbox"/>	<input type="checkbox"/>	
15. Air Governor Cut-In Pressure		Cut-in pressure: about 90 psi	<input type="checkbox"/>	<input type="checkbox"/>	
16. Air Governor Cut-Out Pressure		Cut-out pressure: about 120 psi	<input type="checkbox"/>	<input type="checkbox"/>	
17. Air Dryer Purge Cycle Operation		Cycles when governor cuts-out	<input type="checkbox"/>	<input type="checkbox"/>	
18. Starter Interlock		Starter must not engage when engine running	<input type="checkbox"/>	<input type="checkbox"/>	
19. Front Door & Dome Lights		Must open and close as intended; lights illuminate	<input type="checkbox"/>	<input type="checkbox"/>	
20. Kneeling System and Interlock		Kneeler horn & lights activate; interlock engages; kneels and retracts	<input type="checkbox"/>	<input type="checkbox"/>	
21. Electric Side Mirror Adjustment		Must be operational	<input type="checkbox"/>	<input type="checkbox"/>	
22. Windshield Wipers/Wash		Must operate as intended	<input type="checkbox"/>	<input type="checkbox"/>	
23. Dash Lights/Dimmer Switch		Gauges must illuminate	<input type="checkbox"/>	<input type="checkbox"/>	
24. Dash Tell-Tale Lamps		All squares should illuminate in test mode	<input type="checkbox"/>	<input type="checkbox"/>	
25. Voltage Gauge Readings		12V: 13.8+/- 0.3V 24V: 27.6+/- 0.3V	<input type="checkbox"/>	<input type="checkbox"/>	
26. Speak-Easy Operation		Voice recording must be clearly audible w/door operation	<input type="checkbox"/>	<input type="checkbox"/>	
27. Horn/Steering Wheel Adjustment		Horn must be audible in all S/W positions	<input type="checkbox"/>	<input type="checkbox"/>	









PREVENTIVE MAINTENANCE INSPECTION - SHEET 2

INSPECTION TYPE A B C					
Bus Number		Date:			— —
Drivability Function Checks (Engine Running) - Cont'd					
Performance Checks:	Check Criteria:			OK	NG
28. Steering Wheel Adjustment	S/W must be fully adjustable; all hardware & controls intact			<input type="checkbox"/>	<input type="checkbox"/>
29. Seatbelt/Seat Adjustment	Must be fully adjustable; all hardware & controls intact			<input type="checkbox"/>	<input type="checkbox"/>
30. Sun Visor & Vehicle Registration	Operable and present			<input type="checkbox"/>	<input type="checkbox"/>
31. Fire Suppression System	Manual actuator pull-pin and/or guard in place; system "OK"			<input type="checkbox"/>	<input type="checkbox"/>
	Light is on; pressing "test" triggers audible and visual alarm				
32. Operator's Light	Must be operational			<input type="checkbox"/>	<input type="checkbox"/>
Drivability Function Checks (Engine "Off")					
Action Items:					
	Turn Engine "Off"				
	Turn "On" Interior Lights				
	Activate Rear Door				
Performance Checks:	Check Criteria:			OK	NG
33. Accelerator/Brake Pedals	Roller, plunger and pedal pin all secure and intact			<input type="checkbox"/>	<input type="checkbox"/>
34. Handheld Fire Extinguisher	Present, secure and charged in green zone			<input type="checkbox"/>	<input type="checkbox"/>
35. Interior Mirrors	Present and secure			<input type="checkbox"/>	<input type="checkbox"/>
36. Operator's Stanchion	Present and secure			<input type="checkbox"/>	<input type="checkbox"/>
37. Forward Roof Hatch	Secure, opens and closes			<input type="checkbox"/>	<input type="checkbox"/>
38. Stanchions & Related Hardware	Secure and free of damage			<input type="checkbox"/>	<input type="checkbox"/>
39. Passenger Seats	Secure and clean (free of rips, tears, graffiti, gum, etc.)			<input type="checkbox"/>	<input type="checkbox"/>
40. Interior Decals	Secure, clean and legible			<input type="checkbox"/>	<input type="checkbox"/>
41. Passenger Stop Requests	All touch tapes and pushbuttons are properly indicated			<input type="checkbox"/>	<input type="checkbox"/>
42. Windows	None broken/cracked & are secure, slide and locks			<input type="checkbox"/>	<input type="checkbox"/>
43. Emergency Window Hatches	Open and latch shut as intended			<input type="checkbox"/>	<input type="checkbox"/>
44. Rear Roof Hatch	Opens and closes as intended			<input type="checkbox"/>	<input type="checkbox"/>
45. Interior Lighting	All lights operational. Light panels in place & secure			<input type="checkbox"/>	<input type="checkbox"/>
Rear Door Checks					
Action Items:					
	Turn Engine "On"				
Performance Checks:	Check Criteria:			OK	NG
46. Rear Door "Open" Lights	All green lights illuminate			<input type="checkbox"/>	<input type="checkbox"/>
47. Rear Door Touch Tapes	Left and right door touch tapes activate door opening			<input type="checkbox"/>	<input type="checkbox"/>
48. Door Gap & Push-Pull Test	Gap < 3". Minimal play. Door hinges & seals intact			<input type="checkbox"/>	<input type="checkbox"/>
49. Door Open Interlock Function	Brake is applied & accelerator is disabled when doors are held open following a "Close Door" command			<input type="checkbox"/>	<input type="checkbox"/>
	Bus movement disabled upon a "forced" unauthorized door opening				
50. Door Closed Interlock Function	Stepwell voice recording and/or buzzer is audible			<input type="checkbox"/>	<input type="checkbox"/>
51. Door Cycle Test	Door opens & closes as intended after above steps			<input type="checkbox"/>	<input type="checkbox"/>
Bus Exterior Checks					
Action Items:					
	Turn Master Switch to "Off" then to "Lights" position. (Engine Not Running)				
	Set Destination Sign to Test Pattern. Turn "On" all Exterior Lights				
	Conduct Walk-Around Inspection. Note Body Damage on Bus Diagram Sheet.				
Performance Checks:	Check Criteria:			OK	NG
52. Wipers/Wiper Blades	Secure. Blade edges not worn & free of damage			<input type="checkbox"/>	<input type="checkbox"/>
53. Front Route Sign	Sign illumination operational.			<input type="checkbox"/>	<input type="checkbox"/>
54. Curbside Minor	Secure & undamaged			<input type="checkbox"/>	<input type="checkbox"/>

PREVENTIVE MAINTENANCE INSPECTION - SHEET 3

INSPECTION TYPE A B C							
Bus Number		Date:					
Bus Exterior Checks - Cont'd							
Performance Checks:		Check Criteria:				OK	NG
55. Fuel Cap/Fuel Fill Nozzle		Present, secure & intact. No indication of fuel leakage.				<input type="checkbox"/>	<input type="checkbox"/>
56. Rear Door Seals and Glass		Secure, clean and free of damage				<input type="checkbox"/>	<input type="checkbox"/>
57. Roadside Side Mirror		Secure, undamaged & adjustable				<input type="checkbox"/>	<input type="checkbox"/>
58. Ride Height/Leaning		Front & Rear Door Steps: 14 to 16" (Bus Horizontal)				<input type="checkbox"/>	<input type="checkbox"/>
59. Exterior Lights		Head/Tail/Brake/Directionals/Hi-Beams/Marker/ License Plate Lights all operational				<input type="checkbox"/>	<input type="checkbox"/>
60. Destination Signs		Front/Rear & Side signs provide identical & acceptable readout.				<input type="checkbox"/>	<input type="checkbox"/>
61. Hubodometer		Check for serviceability and security				<input type="checkbox"/>	<input type="checkbox"/>
62. Tire Condition							
		FRONT		REAR			
Record the Following		Left	Right	Left Inner Outer	Right Inner Outer		
Tire Pressure (Front 115+/-3; Rear 105+/-3 psi)		_____	_____				
Tread Depths (Front 4/32; Rear 2/32" Min.)							
Battery Checks							
Action Items:							
		Keep Engine "Off" Hook-Up Battery Load Tester					
Performance Checks:		Check Criteria:				OK	NG
63. Battery Load Test		Charge level "OK"; meter indicates "Good" or "Marginal" Battery				<input type="checkbox"/>	<input type="checkbox"/>
64. Battery Tray		Clean, secure and easy to pull out				<input type="checkbox"/>	<input type="checkbox"/>
65. Battery Cables & Terminals		Clean, secure. No signs of corrosion or damage.				<input type="checkbox"/>	<input type="checkbox"/>
Engine Checks							
Action Items:							
		Pressurize Cooling system (9 psi) Keep Engine "Off"					
Performance Checks:		Check Criteria:				OK	NG
66. Rear Engine Start/Stop/Switch		Engine starts and stops as intended				<input type="checkbox"/>	<input type="checkbox"/>
67. Engine Compartment Lights		Operable; switch hardware intact				<input type="checkbox"/>	<input type="checkbox"/>
68. Radiator and Charge Air Cooler		Clean & free of obstructions and damage				<input type="checkbox"/>	<input type="checkbox"/>
69. Power Steering Reservoir		Level "OK." Indicate quantity added if low: ____ Qts.				<input type="checkbox"/>	<input type="checkbox"/>
70. Coolant System Integrity		Pressurization held; no leaks, loose clamps, rubbing lines				<input type="checkbox"/>	<input type="checkbox"/>
71. Air Intake Hoses & Clamps		Must be secure/no chafing, rubbing or damaged hosing				<input type="checkbox"/>	<input type="checkbox"/>
72. Hydraulic/Transmission Hoses/Lines		Must be secure/no chafing, rubbing or damaged hosing				<input type="checkbox"/>	<input type="checkbox"/>
73. Fire Suppression Hoses/Nozzles		Secure and intact. Nozzle endcap in place				<input type="checkbox"/>	<input type="checkbox"/>
74. Alternator and Hydraulic Pumps		Secure and no indication of leakage				<input type="checkbox"/>	<input type="checkbox"/>
75. Engine and Accessory Belts		Belts show no signs of wear, splitting or fraying				<input type="checkbox"/>	<input type="checkbox"/>
76. Alternator and Starter Connections		Cables and terminals secure and free of corrosion				<input type="checkbox"/>	<input type="checkbox"/>
77. Exhaust System Integrity		Secure & intact; free of damage; no signs of exhaust leakage				<input type="checkbox"/>	<input type="checkbox"/>
78. Wiring, Harness and Tie-Downs		Secure & intact; wires not subject to heat or vibration damage				<input type="checkbox"/>	<input type="checkbox"/>
79. Fan and Fan Shroud		Secure & intact; free of damage				<input type="checkbox"/>	<input type="checkbox"/>

PREVENTIVE MAINTENANCE INSPECTION - SHEET 4

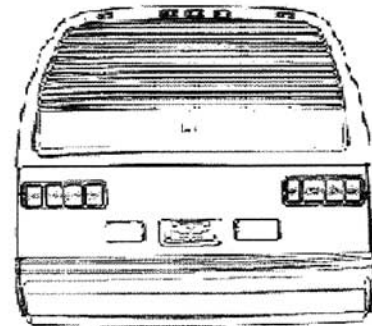
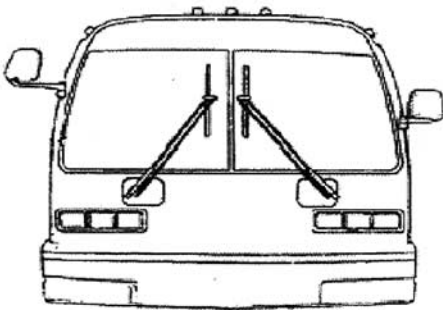
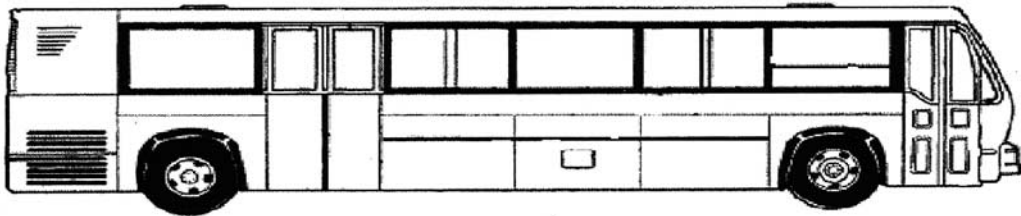
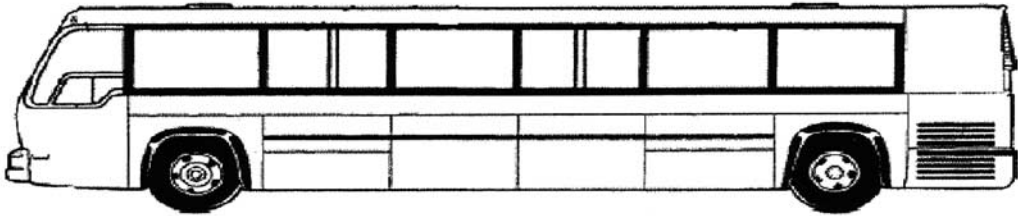
INSPECTION TYPE A B C					
Bus Number		Date:			
Undercarriage Checks					
Action Items:					
	Keep Engine "Off"				
	Raise and Support Bus with Safety Stands				
	Drain all Air Tanks until Free of Contaminants				
Performance Checks:		Check Criteria:		OK	NG
80. Miter Box and Steering Linkages		Securely mounted and no sign of leakage		<input type="checkbox"/>	<input type="checkbox"/>
81. Steering Linkages		No excessive play or damage; all boots in-place		<input type="checkbox"/>	<input type="checkbox"/>
82. Defroster Valve		Filter clean and no indication of leakage		<input type="checkbox"/>	<input type="checkbox"/>
83. Suspension System		Shock absorbers & air bags secure and tight; no air leakage		<input type="checkbox"/>	<input type="checkbox"/>
84. Ride Leveling System		Leveling links, airlines & leveling valves intact; no air leakage		<input type="checkbox"/>	<input type="checkbox"/>
85. Hoses/Pipes/Clamps/Wiring		Secure & intact; no splitting, rubbing or corrosion		<input type="checkbox"/>	<input type="checkbox"/>
86. Axle, Radius Rods & Bushings		No cracks, movement or excessive rust; all rubber intact		<input type="checkbox"/>	<input type="checkbox"/>
87. Air Tanks, Fuel Tanks & Hardware		Secure & free of damage. No leakage/excessive contamination		<input type="checkbox"/>	<input type="checkbox"/>
88. Chassis Structure & Underbody		No cracks or excessive rust in welds or steel supports		<input type="checkbox"/>	<input type="checkbox"/>
89. Driveshaft/U-Joints		Secure. No excessive rust		<input type="checkbox"/>	<input type="checkbox"/>
90. Bulkhead Electrical Connections		Secure. No corrosion or frayed wires		<input type="checkbox"/>	<input type="checkbox"/>
91. Differential Oil Level		Filled. No signs of leakage, cracks or excessive rust		<input type="checkbox"/>	<input type="checkbox"/>
92. Engine and Transmission Housing		No oil leaks, cracks or other visible damage.		<input type="checkbox"/>	<input type="checkbox"/>
93. Engine & Transmission Cradle Mts.		Secure & intact. No splits or cracks in rubber material.		<input type="checkbox"/>	<input type="checkbox"/>
94. Fire Suppression Agent Bottle		Secure & charged; actuator head wiring secure & intact		<input type="checkbox"/>	<input type="checkbox"/>
Engine Oil and Filter Change					
Action Items:					
	Keep Engine "Off"				
	Keep Bus Supported with Safety Stands				
	Remove Oil Pan Drain Plug				
	Drain Oil into Oil Collection Tank and Obtain Sample for Later Analysis				
	Remove Old Oil Filter and Replace with New One				
	Fill Engine Oil Pan with Proper Amount of Oil (after lowering bus)				
Performance Checks:		Check Criteria:		OK	NG
95. Drain Plug		Inspect for excessive metal fragments and clean		<input type="checkbox"/>	<input type="checkbox"/>
96. Removed Oil		Inspect oil for contaminant, water, antifreeze, fuel and metal fragments		<input type="checkbox"/>	<input type="checkbox"/>
97. Plug and Pan Treads		Inspect for serviceability		<input type="checkbox"/>	<input type="checkbox"/>
98. Engine Oil Pan, Filters & Lines		Start engine and check for oil leaks		<input type="checkbox"/>	<input type="checkbox"/>
99. Engine Oil Level		Turn off engine and check for proper oil level		<input type="checkbox"/>	<input type="checkbox"/>
Kingpins					
Action Items:					
	For Portable Type Lifts: Lower front end of bus so it is supported entirely by safety stands				
	For Axle Support Lifts: Place a pinch-bar in the lowest vent hole of the front wheels				
Performance Checks:		Check Criteria:		OK	NG
100. Kingpins		Check for excessive up & down and side-to-side play		<input type="checkbox"/>	<input type="checkbox"/>

PREVENTIVE MAINTENANCE INSPECTION - SHEET 5

INSPECTION TYPE A B C																		
Bus Number		Date																
Brakes																		
Action Items: <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> </div> <div> <p>Release Parking Brake & Actuate Service Brakes (w/air system at 90 to 100 psi)</p> <p>Measure Brake Lining Wear. Check for any Air Leakage.</p> </div> </div>																		
Performance Checks:		Check Criteria:			OK	NG												
101. Air System Integrity		Any indication of leakage			<input type="checkbox"/>	<input type="checkbox"/>												
102. Brake Shoe Movement (Wedge Brakes Only)		Brakes fully apply and retract with each application			<input type="checkbox"/>	<input type="checkbox"/>												
103. Brake Throws (S-Cam Brakes Only)		Front: 2.0" max. Rear: 2.5" max. (Orange "Warning" band on Push-rod is NOT visible)			<input type="checkbox"/>	<input type="checkbox"/>												
104. Brake Shoe Pad Depth (min. 3/8")		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">Front</th> <th colspan="2" style="text-align: center;">Rear</th> </tr> <tr> <th style="text-align: center;">Right:</th> <th style="text-align: center;">Left:</th> <th style="text-align: center;">Right:</th> <th style="text-align: center;">Left:</th> </tr> </thead> <tbody> <tr> <td style="height: 40px;"></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					Front		Rear		Right:	Left:	Right:	Left:				
Front		Rear																
Right:	Left:	Right:	Left:															
105. Parking Brake Extension (if applicable)		Engaged: 10.5" to clevis pin. Disengaged: 12" to clevis pin Lining clearance: 0.010 to 0.015"			<input type="checkbox"/>	<input type="checkbox"/>												
					—	—												
Wheels/Miscellaneous																		
Action Items: <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> </div> <div> <p>Lower Bus from Lift</p> <p>Torque Wheel Lug Nuts as Follows: Front: 500 ft.-lbs., Rear: 550 ft.-lbs.</p> </div> </div>																		
Performance Checks:		Check Criteria:			OK	NG												
106. Wheel Integrity		No excessive rust or noticeable cracks in wheels			<input type="checkbox"/>	<input type="checkbox"/>												
107. Lug Nuts		No missing lug nuts			<input type="checkbox"/>	<input type="checkbox"/>												
108. Other					<input type="checkbox"/>	<input type="checkbox"/>												

DEFECT SHEET[illegible]

**GMC/RTS/NOVA
BODY DAMAGE DIAGRAM**



SAMPLE MAINTENANCE PRACTICE #2

Bus PMI; 2003 STARTRANS Senator, 20-Ft.; Ford E-350 Chassis

This sample practice was prepared in cooperation with RADAR, Unified Human Services Transportation Inc., Roanoke, VA, and is based on their General Inspection Sheet and maintenance manuals provided by Supreme, Ford, and Haynes.

Date March 20, 2005 (Original Issue)

Legal Disclaimer/Source

The following disclaimer is used when this practice is posted on the TRB Maintenance Practices Web Board; remove for internal agency use:

The information contained in the published content is provided as a service to the bus transit community and does not constitute advice. Every attempt was made to provide quality information for the purposes outlined for this project, but we make no claims, promises, or guarantees about the accuracy, completeness, or adequacy of the content. Maintenance advice must be tailored to the specific circumstances of each agency. Because bus maintenance practices can change without notice, nothing provided herein should be used as a substitute for the advice of competent mechanics and/or maintenance crews.

Objective/Purpose

This maintenance practice is used in conjunction with the attached Inspection Sheet and provides instructions for performing a Preventive Maintenance Inspection (PMI) on a STARTRANS 20-foot Senator bus built by Supreme on a Ford E-350 chassis.

Summary of Local Conditions

- Buses operate in Demand Response Service in urban, suburban, and rural areas, including city streets and hilly neighborhood roads.
- PMIs are performed in a central maintenance facility without pits or in-ground lifts. Inspections are done with floor jacks and jack stands.
- Winter operation includes ice and snow. Summers are typically hot and humid.

Special Tools

Torque Stick, 140 lb-ft MAC Tools – Wheel Torque Extension Kit

Safety Precautions/Applicable Regulations

- Wear proper eye and hand protection.
- Attach exhaust hose to bus exhaust system when operating indoors.
- Use safety stands (jack stands) to support vehicle.
- This practice was written to comply with United States Department of Transportation (USDOT) requirements; CFR 49 Part 393 and CFR 49 Part 396

Hazardous Materials

Use special containers to properly dispose of waste oil and filters because they are classified as hazardous materials. Use latex gloves when handling waste oil and filters.

Step-by-Step Procedures (5,000-mile PMI interval)

The inspection technician must use the attached Preventive Maintenance Inspection (PMI) Sheet along with the instructions provided below:

1. The bus engine compartment and undercarriage must be steam cleaned and allowed to cool prior to starting the inspection.
2. Record the bus number, date of inspection, inspection due date, and bus mileage on the attached Inspection Sheet.
3. The inspection steps shown on the PMI Sheet must be followed in the order shown.
4. For each inspection item, check the "Good" or "No Good" column and initial. If an inspection item is found to be "No Good," a description of the problem must be noted. If corrections are made, that should be noted as well.
5. Where measurements are requested, record the measured values.
6. The completed PMI Sheets are then filed with the appropriate bus records file.

**Preventive Maintenance Inspection (PMI) Sheet
2003 STARTRANS Senator, Ford E-350 Chassis**

Bus Number _____ Date Inspection Due ____/____/____ Date Inspection Complete ____/____/____ Mileage _____

Operator Controls Checks

		Good	No Good	Mech.Init.
Dash lights/dimmer	Must operate properly			
Dash telltale lamps	Must be on in test mode			
Voltage gauge reading	13.8 ± 0.3 volts			
Passenger door, seals & dome lamp	Must operate properly, clean & seals properly, lubricate hinges and opening mechanism			
Operator door	Check alignment, latch and seals, lubricate hinges and latch			
Operator door window	Check for proper operation and damage			
Horn & flashers	Must operate properly			
Steering wheel tilt	Must operate properly			
Operator stanchions	Present, secure			
Operator seat	Must be fully adjustable, all hardware and controls intact, check seat mounting bolts are tight			
Operator seat belt	Must be adjustable, retract and latch properly, inspect for damage			
Sun visor and registration	Present, secure			
Fire extinguisher	Present, secure & charged within green zone			
Flares and reflective hazard kit	Check contents and replenish as required			
First Aid kit	Check contents and replenish as required			
Interior mirror	Present, secure & adjustable			
Driver's side mirror	Present, secure, adjustable & undamaged			
Curb side mirror	Present, secure, adjustable & undamaged			
Windshield	Clean and inspect for damage			
Wipers/wiper blades	Proper operation, blade edges not worn or damaged			
Windshield washer	Check operation, proper spray pattern, fill reservoir			
Back-up alarm	Must be audible from driver's seating area			
Fast idle switch	Check for proper operation			
Defroster & frt heater blower	Check by turning on fan and defroster with engine running (fall & winter)			
Front heater	Check operation with engine running (winter)			
Air conditioning - operator	Check by turning on A/C and control to cool (summer)			

Interior Checks

Interior lights	All lights operational, light panels in place & secure			
Roof hatch	Secure, opens, closes and seals properly			
Passenger stanchions	Secure and not damaged			
Passenger seats	Secure, clean & free from damage (tears, cuts, graffiti, gum); check for loose fasteners and mounting bolts			
Windows	Secure, proper operation & no excessive damage			
Passenger door operation	Check operation, open then close door			
Passenger door seals	Inspect for damage			
Heater - passenger compartment	Check operation using temperature and fan control (fall & winter)			
Step well	Check for clean, no loose treads			
Step well lights	Check operation and clean			
Step well heater	Check for proper operation (winter)			
A/C - passenger compartment	Check operation, turn A/C on and control to cool (summer)			
Floor covering/carpet	Check for wear, loose or excessive dirt			

Passenger door/brake interlock	Check by trying to move bus with passenger door open			
Emergency exit door	Check for proper operation and latch properly			
Emergency exit warning lights	Check for proper operation			

Wheelchair Lift and Restraints

Wheelchair lift	Cycle lift and check operation, lubricate all moving parts			
Wheelchair lift/brake interlock	Check by trying to move the bus with the wheelchair lift deployed			
Wheelchair restraints	Check for present, clean and operational			

External Checks

Head lights – high and low	Operational			
Tail lights, directional, marker, license plate, back-up, daytime running lights, four-way flashers	Secure, clean & operational			
Reflectors	Check for damage and clean			
Fuel cap	Present, secure and intact, no signs of leakage			
Body damage – outside panels & bumpers	Check for damage			
Exterior compartment doors	Check for damage, proper latching, lube hinges and check for looseness			

Wheels

Wheels	Check for excessive rust or noticeable cracks			
Wheel attachment	All studs and lug nuts present			
Wheel torque	Torque all lug nuts to 140 lb-ft (126 to 170 lb-ft)			

Tire Condition

All tires	Inspect tires for damage (bulges, cuts, punctures)			
Valve stems and caps	Check valve stems for damage and missing valve caps			
Rotate tires	Rotate as required			

Record tire pressure and tread depth	Front		Rear			
	Left	Right	Left		Right	
			(outer)	(inner)	(outer)	(inner)
Tire pressure (front 65 psi, rear 60 psi)						
Tread depth (front x/32", rear x/32" min) (check visually)						

Engine Compartment

Accelerator linkage	Check for binding, free operation, excessive play			
Air intake - check air filter and replace as required	Check for extreme dirt or restriction			
Engine oil	Dipstick present and oil level proper			
Radiator fluid level	Check for full			

Anti-freeze	Add only 50/50 mixture as required			
Radiator cleanliness	Clean, free of obstructions			
Leaks, oil, fuel, water	Check for any leaks			
Fuel filter	Check for leaks and restriction			
Electrical wiring, harnesses and tie-downs, battery cables and terminals	Check for loose or corroded terminals, loose wiring and tie-downs, chafing, rubbing or frayed wiring			
Battery mounting	Check hold down clamps, tight and good condition			
Transmission fluid	Dipstick present and fluid level proper			
Brake fluid	Check for proper fluid level			
Power steering fluid	Check for proper fluid level			
Windshield washer fluid	Check for proper fluid level			
Belts	Check all belts for looseness and proper tension. No signs of wear or fraying			

Air Conditioning System

A/C compressor	Check compressor and platform mounting bolts for tightness			
A/C compressor belt	Check condition and tension			
A/C compressor clutch	Check for signs of overheating or slippage			
A/C compressor clutch	Check wiring harness			
A/C system	Inspect hoses and clamps, check for leaks, check receiver tank sight glass, check refrigerant charge			
Condenser fan	Inspect fan blades for damage and proper tip-to-shroud clearance			
Evaporator	Check air temperature in and out. ΔT should be 15-20 °F			
Evaporator fins	Clean coils and straighten bent fins			
Refrigerant valves	Inspect cap seals for damage and valve caps for tightness			
Evaporator blower motor	Check fan wheel alignment and mounting bolts for tightness			
Refrigerant pressure	Check with manifold gauge			

Chassis

Steering system	No excessive play or damage			
Suspension system	Shock absorbers intact and no signs of leakage. Springs and mounting satisfactory			
Axles, radius rods & bushings	No cracks, movement or excessive rust. All rubber intact.			
Chassis structure/underbody	No cracks or excessive rust in welds or supports			
Driveline and U-joints	Secure. No excessive rust.			
Differential	Full. No signs of leaks, cracks or excessive rust.			
Hoses/pipes/clamps/wiring	Secure and intact. No chaffing rubbing or corrosion			
Engine & transmission housings	No leaks, cracks or visible damage.			
Engine & transmission mounts	Secure and intact. No splits or cracks in rubber material.			
Exhaust system	Inspect for damage, leaks, loose parts and debris trapped by exhaust system			
Brake system	Check lines and brake assembly for leaks			
Brake lining and rotors	Visually inspect rotors and pads			

SAMPLE MAINTENANCE PRACTICE #3

Title

Component PMI; Thermo King Model T11-M85 AC with IntelligAIRE II; 2004; Gillig, 30-foot low floor

Agency Name

This sample practice was prepared with assistance provided by the Potomac and Rappahannock Transportation Commission (PRTC), Woodbridge, Virginia, and is based on service information and manuals provided by the Thermo King Corporation.

Date

March 1, 2005 (Original Issue)

Web Board Disclaimer

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Copyright Information

The information contained in this maintenance practice is based on copyrighted information provided by the Thermo King Corporation as contained in their maintenance and service manuals. Permission to use the copyrighted material was granted by the Thermo King Corporation.

Objective/Purpose

The purpose of this PMI is to determine the state of readiness of the air conditioning system and to identify any defects needing repair. The technician is authorized to make a repair if it will take 15 minutes or less for each defect identified. Repairs taking more than 15 minutes must be noted on the attached Defects and Parts Record Sheet and will be done as a scheduled repair activity. This PMI is to be performed at 6,000-mile intervals in conjunction with the standard 6,000-mile Bus PMI.

Glossary of Terms

AC—Air Conditioning System

PMI—Preventative Maintenance Inspection

Summary of Local Conditions

- Inspectors are allowed to make any repair estimated to take 15 minutes or less; otherwise, defects are noted and scheduled for repair at a later time.
- The agency experiences mild winters and long hot humid summers.
- The AC system is kept operational all year.

Parts

- Air Filters—Thermo King 91-6291
- Protective Cap—Thermo King 306-115

Additional Information Available

The following troubleshooting and repair procedure manuals for the AC system can be found in the Supervisor's Office to provide additional information if needed:

- Thermo King—Maintenance Manual T11 M85 (02/01/05)
- Thermo King—X426, X430 Compressor Overhaul for Bus Air Conditioning
- Thermo King—Operator's Manual SMART Pac Software for IntelligAIRE II
- Thermo King—Parts Manual T11 M85
- Thermo King—Tool Catalog TK5955-0-MS (04/03)

Time Standard

None

Special Tools

Thermo Cycle Vortex Tester—Thermo King Tool 204-949

This tool provides hot or cold air for testing sensors.

Attach the hot/cold air to a compressor and it will blow hot air out one orifice and cold air out the other. Use it for cycling the thermostat by aiming it at the sensor bulb.

204-949 Hot/Cold air gun



Thermometer (-40 to + 160 F)—Thermo King Tool 204-233

Handy pocket thermometer for quick temperature checks.

204-233 Thermometer (-40 to 160 F)

204-448 Thermometer (-40 to 70 C)



Safety Precautions/Applicable Regulations

- Keep your hands, clothing and tools clear of fans, pulleys, and drive belts when working on an AC unit that is running. Loose clothing can get entangled in this moving equipment, causing serious injury or possible death.
- Regulations require that goggles/safety glasses and gloves be worn when working around AC systems or batteries. Refrigerant, oil, and battery acid can permanently damage your eyes.
- Use extreme caution when adding coolant to a hot engine; release pressure slowly to prevent hot fluid from escaping quickly, which can burn skin and eyes.
- Do not use a torch when working on AC systems. When a flame comes in contact with refrigerant, toxic gases are produced that might cause suffocation or even death.
- Regulations require that refrigerant (including R-134a) be recovered and recycled using a certified recovery system, that the equipment be operated by a licensed employee, and that any refrigerant added to the AC system be tracked and inventoried. As a result of this regulation:
 - o Only certified technicians are allowed to perform this PMI.
 - o Refer to the practice on Recycling and Replacement of Refrigerant if needed.
 - o Any refrigerant used must be logged into the attached Defects and Parts Record Sheet in the space provided.
- The agency contracts with an outside firm to audit maintenance performance and will check agency records to verify if licensed personnel are performing AC PMIs.

Hazardous Materials

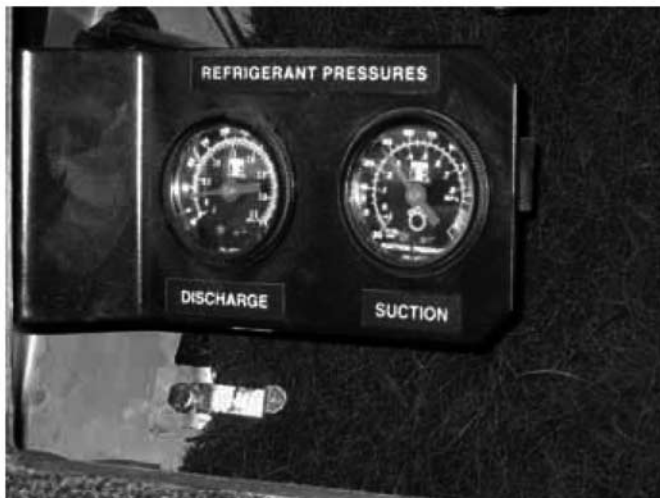
All refrigerant, including R-134a, is considered a hazardous material. The refrigerants can cause freezing of skin and eyes. Avoid contact and always wear eye and hand protection. Refer to the practice on Recycling and Replacement of Refrigerant if needed for additional information.

Procedure

1. Set parking brake. Start and warm up engine to full operating temperature. Shut off engine. Open engine compartment door and set Ignition Select switch to the "OFF" position.



2. Open rear AC compartment door and converter door, and swing open compressor belt guard.
3. Open evaporator filter panel. Remove filters and check evaporator for cleanliness. Clean as necessary. Replace filters.
4. Open interior AC panel cover. Using the pressure gauges (located in the lower left of the interior evaporator compartment) record static pressures below. Compare readings to Thermo King temperature/pressure relationship chart (provided below) according to the current ambient temperature for R-134a. Pressures should equal those indicated by ambient temperature. Elaborate on any defects on attached Defects Record Sheet.



Record Readings

Ambient Temperature ____°F

Static Suction ____PSIG

Static Discharge ____PSIG

Temperature Pressure Relationship				
Vapor Pressure, psig				
F	C	R-22	R-134a	R-407C
52	11.1	87.5	47.3	80.4
54	12.2	91.0	49.7	83.9
56	13.3	94.5	52.1	87.4
58	14.4	98.0	54.5	91.0
60	15.6	101.6	56.9	94.8
62	16.7	105.5	59.6	98.6
64	17.8	109.5	62.4	102.5
66	18.9	113.4	65.1	106.5
68	20.0	117.4	67.9	110.7
70	21.1	121.4	70.7	114.9
72	22.2	125.8	73.8	119.3
74	23.3	130.2	76.9	123.7
76	24.4	134.7	80.1	128.3
78	25.6	139.1	83.2	133.0
80	26.7	143.6	86.4	137.8
82	27.8	148.5	89.9	142.7
84	28.9	153.5	93.5	147.8
86	30.0	158.4	97.0	153.0
88	31.1	163.4	100.6	158.3
90	32.2	168.4	104.2	163.7
92	33.3	173.9	108.2	169.2
94	34.4	179.4	112.2	174.9
96	35.6	184.9	116.2	180.7
98	36.7	190.4	120.2	186.7
100	37.8	195.9	124.3	192.8
102	38.9	201.9	128.9	199.0
104	40.0	208.0	133.3	205.3
106	41.1	214.1	137.8	211.9
108	42.2	220.2	142.3	218.5
110	43.3	226.3	146.8	225.3

5. Inspect liquid line indicator in AC compartment for moisture content. Record color below.

Green (dry) _____ Yellow (wet) _____



6. Inspect compressor clutch for evidence of wear, overheating, and broken friction plate or springs. Inspect for leaks at front compressor seal. Mark as acceptable or defective. Elaborate on any defects on attached Defects Record Sheet.

Clutch Condition: Acceptable _____ Defective _____



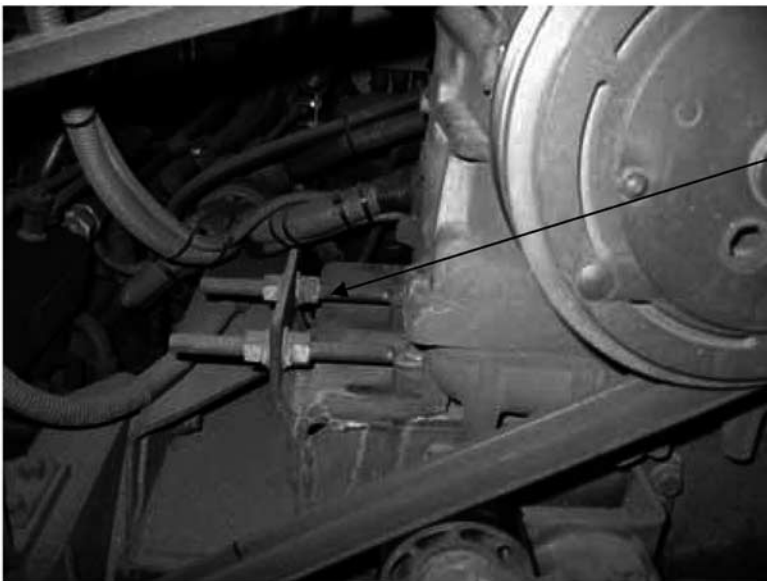
Clutch



Front Seal

Front Seal Condition: Acceptable _____ Defective _____

7. Inspect compressor-mounting flange and bracket for cracks. Inspect pivot for damage or loose/missing bolts. Mark as acceptable or defective. Elaborate on any defects on the attached Defects Record Sheet.

Mounting
Flange

Mounting Flange: Acceptable _____ Defective _____

Loose/Missing Bolts: Acceptable _____ Defective _____

8. Inspect compressor drive belt and belt tensioner pulley for wear, tension, and alignment. Mark as acceptable or defective. Elaborate on any defects on the attached Defects Record Sheet.

Belt Condition: Acceptable ____ Defective ____

Belt Tensioner Pulley: Acceptable ____ Defective ____

9. Inspect all electrical harnesses and refrigerant lines around compressor area for rubbing, chafing, or corrosion. Ensure that the wire connections are secure at pressure switches. Mark as acceptable or defective. Elaborate on any defects on the attached Defects Record Sheet.

Acceptable ____ Defective ____

10. Inspect for proper engine coolant level (Warning: If adding coolant, release pressure slowly when hot). Visually inspect the entire AC unit, evaporator/heater coil compartments, and connecting lines for evidence of any engine coolant leaks. Mark as acceptable or defective. Elaborate on any defects on the attached Defects Record Sheet.

Acceptable ____ Defective ____

11. In the engine compartment, close the compressor belt guard and place the Ignition Select switch to the "REAR" start position. (Note: Interior temperature must be between 60° and 76°F; if less than 60°F, start up the engine and turn on interior heat until the temperature is between 60° and 76°F). Turn off heat and turn on the AC system at driver's control panel.
12. At driver's position, operate the engine at fast idle speed. Run AC system for 15 minutes before recording readings. Using pressure gauges installed in the lower left of the interior evaporator compartment, record pressures and temperatures at both idle and fast idle speeds.

**Engine at Idle Speed**

Suction _____PSIG

Discharge _____PSIG

Engine at Fast Idle Speed

Suction _____PSIG

Discharge _____PSIG

Ambient Temperature _____°F

Return Air Temperature ____°F

Delivery Air Temperature ____°F

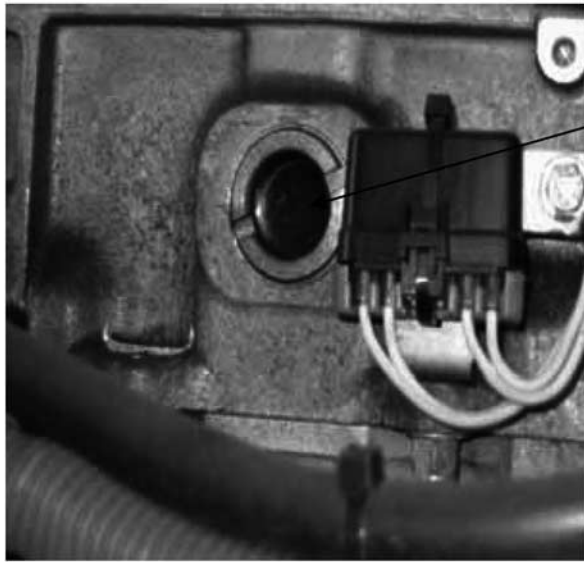
13. In the AC compartment, inspect the refrigerant level in the receiver tank sight glass. Refrigerant level should be between $\frac{1}{2}$ and $\frac{3}{4}$. Record level:

Refrigerant Level: _____



14. Inspect protective caps on service valves. Replace any missing caps.

15. In the converter door area, inspect compressor oil level and color in compressor oil sump sight glass. Oil level should be between $\frac{1}{2}$ and $\frac{3}{4}$. Record level and color:



Sight
Glass

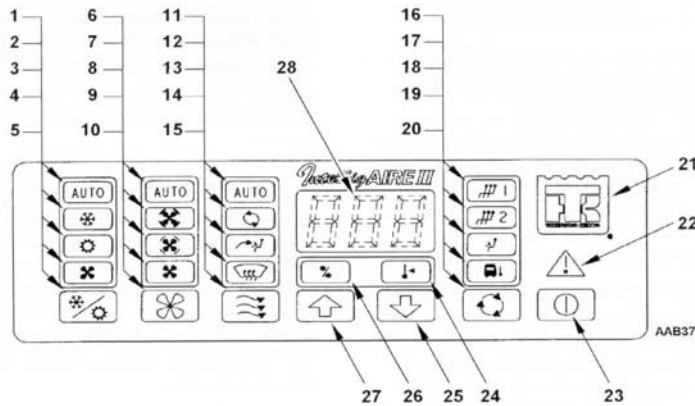
Oil Level_____

Oil Color: Amber: _____ Black or Metallic Gray_____ Brown: _____

16. In bus interior, use the Thermo Cycle Vortex Tester (Thermo King Tool 204-949) to check return air thermostat function by raising and lowering return air thermostat temperature to cycle unit in heat, cool, reheat, and vent operating modes. Inspect for abnormal noises and vibration of condenser and evaporator motors, compressor, and clutch. Mark as acceptable or defective. Elaborate on any defects on the attached Defects Record Sheet.

Acceptable: _____ Defective: _____

17. In bus interior, place the IntelligAire II Display Module in the “RT” Relay Test mode. The Relay Test manually energizes relay outputs one at a time, allowing relays to be latched on for diagnosis.



1.	Auto Mode Indicator	15.	DAMPER SELECT Key
2.	Cool Mode Indicator	16.	Passenger Zone 1 Return Air Temperature Indicator
3.	Heat Mode Indicator	17.	Passenger Zone 2 Return Air Temperature Indicator
4.	Vent Mode Indicator	18.	Driver's Zone Return Air Temperature Indicator
5.	OPERATING MODE SELECT Key	19.	Ambient Air Indicator
6.	Auto Fan Speed Indicator	20.	DISPLAY, SELECT Key
7.	High Fan Speed Indicator	21.	THERMO KING LOGO Key
8.	Medium Fan Speed Indicator	22.	Warning Indicator
9.	Low Fan Speed Indicator	23.	ON/OFF Key
10.	FAN SPEED SELECT Key	24.	Setpoint Indicator
11.	Auto Damper Indicator	25.	DOWN ARROW Key
12.	Recirculate Mode Indicator	26.	Percent Indicator
13.	Driver's Panel Air Indicator	27.	UP ARROW Key
14.	Defrost Indicator	28.	LED Display

- To initiate the Relay Test, press either the up or down arrow key when (RT) appears in the display. When initiated, the Relay Test turns on the first relay.
- To scroll through the relay tests, press either the up or down arrow key. The output on the digital display is turned on and all other outputs are turned off. Consult the unit schematic diagram to determine what component(s) are controlled by each output. Note: The controller has time limits for outputs that can cause damage if left on too long.
- To exit the Relay Test at any time, press the Display Select key.

Ensure that the main and sidewall water valves are opening and closing when the unit cycles on/off (lines should be warm when operating) and check coolant booster pump seal for evidence of leaks. Mark as acceptable or defective. Elaborate on any defects on the attached Defects Record Sheet.

Acceptable: _____ Defective: _____

18. At driver's area, visually and audibly inspect:

Driver's booster fan operation. Mark as acceptable or defective.

Acceptable: _____ Defective: _____

Defroster fan high and low speed operation. Mark as acceptable or defective.

Acceptable: _____ Defective: _____

Front water valve condition and operation. Mark as acceptable or defective.

Acceptable: _____ Defective: _____

Record defroster duct outlet temperature: _____ °F

Elaborate on any defects on the attached Defects Record Sheet.

19. In the engine compartment, place starter Ignition Select switch to "FRONT" start position. Close all panels, compartment, and access doors.

20. Complete Defects Record Sheet and return all material to your Supervisor.

Inspection performed by: _____

Employee #: _____

Date: _____

AC System

Defects and Parts Record Sheet

Bus number_____

List remaining defects:

1)_____

2)_____

3)_____

4)_____

5)_____

Record all parts used:

Part No.	Description	Quantity
----------	-------------	----------

1)_____

2)_____

3)_____

4)_____

5)_____

Record Refrigerant used: Pounds_____

Repairs performed by:_____

Employee #: _____

Employee Certification #: _____

Date:_____

SAMPLE MAINTENANCE PRACTICE #4

Title

Electrical; Repair; All buses

Agency Name

This sample practice was prepared with assistance provided by the Potomac and Rappahannock Transportation Commission (PRTC), Woodbridge, Virginia, and is based on service information and manuals provided by several sources, including TMC Recommended Practice 129, Heavy-Duty Vehicle System Wiring Checks: 12-Volt Charging, 12-Volt Cranking; and electrical training material provided by the Thermo King Corporation.

Date

February 1, 2005 (Original Issue)

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Copyright Information

The majority of information contained in this maintenance practice is based on illustrations and material provided by the Thermo King Corporation in their electrical training manuals. Permission to use the copyrighted material was granted by the Thermo King Corporation. TMC Recommended Practice 129 was used as reference material only.

Objective/Purpose

The purpose of this practice is to provide an introduction to electrical circuit failures and meter usage. It also outlines general electrical troubleshooting and repairs. This practice can be applied to all buses and covers power source and component wiring for 12 and 24

volts direct current (VDC) applications. Additional repairs may require the use of specific tools, repair connectors, and specific techniques. Consult specific component manuals and user instructions for these cases.

Glossary of Terms and Abbreviations

A: Amp

Conductor: Element of the wire (typically copper) that carries electrical current

DC: Direct Current

Heat gun: Electrical tool to heat-shrink tubing on connections/terminals

Prod: Positive and negative probe of VOM test instrument used to conduct electrical tests. They are also referred to as leads.

V: Volt

VDC: Volts Direct Current

VOM: Volt/Ohm/Milliammeter; also known as “multimeter”

Wire Crimper: Tool to crimp connector/terminals onto wire conductors

Wire Striper: Tool to strip insulation from ends of wires without damaging conductor

Summary of Local Conditions

Not applicable.

Parts

Shrink tubing, wire, and connectors as needed.

Time Standards

Not applicable.

Special Tools

VOM: An electrical testing device that combines a voltmeter, an ohmmeter and a milliammeter (ammeter) into a single “multimeter” instrument. There are two types. The first is an electro-mechanical meter using a moving coil. This type, while accurate, is fragile and prone to damage. The second and preferred type is an electronic (digital) meter that is more accurate and durable. This practice will describe the use of the digital VOM. A typical digital VOM is shown below. (For those with Internet access, visit the <http://us.fluke.com/VirtualDemos> site for an interactive demonstration of how to use a digital VOM).

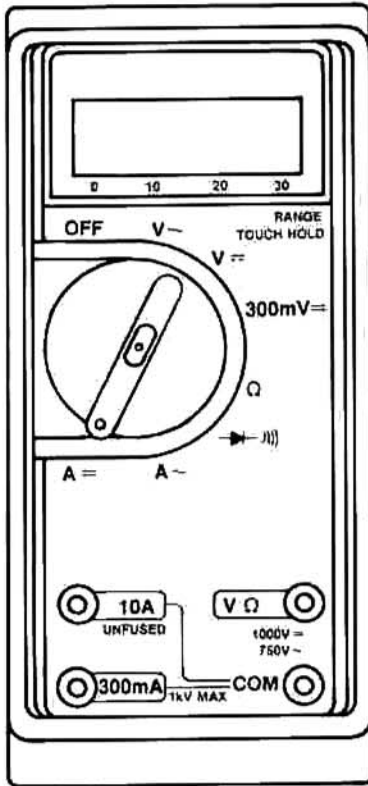


Illustration used with permission from the Thermo King Corporation.

Clamp-on Ammeter: The clamp-on ammeter is used as a stand-alone instrument or as an attachment to a VOM to measure current in a conductor by surrounding the conductor (wire) to measure the magnetic field around it.

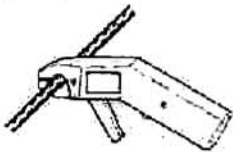


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Safety Precautions

- Always be aware of the potential danger to yourself and equipment when working with energized (activated) electrical circuits.
- There is a possibility of receiving a damaging electrical shock created by contacting energized circuits; always try to work with de-energized circuits if possible.
- Work with only one hand when power is on.
- If readings must be made of an energized circuit, make connections on the de-energized circuit first and then energize the circuit when taking the readings.

- Always wear safety-approved shoes, eye protection, and gloves when working on electrical equipment.
- Insulate yourself from earth ground by using an insulating floor mat.
- *Do not use jumper cables or test lamps* as substitutes for VOMs. They can easily damage electronic circuits and equipment.

Procedures

The procedures below describe:

- Circuit defects;
- Troubleshooting procedures (identification of defects); and
- Repairs (correcting defects found during troubleshooting).

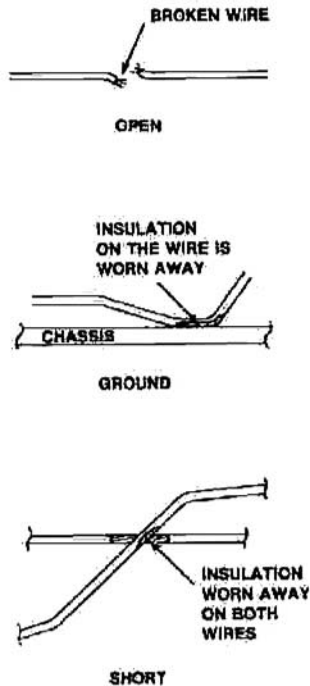
Circuit Defects

When components like lamps, motors, or other electrical devices fail to operate as commanded (i.e., when switched on or off), there is a defect either in the circuit external to the device or in the device itself. External circuit defects can be in the power source (battery or alternator), connecting wires, or terminals/connectors. Defects to the electrical device can be due to worn/defective internal components, such as brushes, diodes, and lamps.

Typical circuit failures are caused by an Open, Ground, or Short condition.

- An Open circuit is a break—such as a broken wire, terminal, or connector—that stops current flow.
- A Ground circuit results when a conductor or device contacts a portion of the bus that is at ground potential (i.e., ultimately connected to the ground side of battery). This circuit results in excessive current flow and usually trips fuses or breakers, which cuts power to the circuit to prevent serious damage.
- A Short circuit is when two separate conductors (with at least one having power) make unintentional contact. The circuit results are similar to a Ground circuit.

Typical circuit defects are shown below:



Illustrations used with permission from the Thermo King Corporation.

Troubleshooting Procedures (Identification of Defect)

1. Background. Circuits are created by using wires to connect electrical components to power (positive [+] side of battery) and ground (negative [-] side of battery). While all power and grounds are connected to the battery, some power [+] may be taken directly from the alternator, starter, relays or other components that are energized from the battery. Likewise, grounds may come from the chassis or other metal components that are ultimately connected to the battery (i.e., through grounding strap/cable).

- Voltage provides the electrical pressure or force that causes the electrical current (electrons) to flow through a circuit. Electrical voltage is measured in volts.
- Resistance is a restriction of current flow that can be detected by voltage decrease or loss in an electrical circuit. Electrical resistance is measured in ohms.
- Current is the flow or movement of electrons through the wires and can be compared to the flow of water through a pipe. Without pressure (voltage), however, current will not flow. Electrical current is measured in amps.
- Buses are either 12 or 24 volts direct current (VDC) or have a combination of both voltages.

2. General Instructions. It is critical to identify the defect before repairs are undertaken. When an electrical device (e.g., lamp, motor, or destination sign) does not operate properly, the defect that prevents operation must first be identified. Below are general procedures to determine if the power supply/ground circuits or the item of equipment is defective. It is important to review the electrical schematic diagrams of the subject circuits to determine the points in the circuit that should be used as test points. Typical test points are terminal strips, connectors, and the device itself. Obtain voltage, current, and resistance specifications for devices in the circuit to evaluate readings. If these procedures fail to identify the defect, then the manufacturer-specific maintenance and troubleshooting manuals must be consulted.

3. Visual Inspection.

Wires: look for broken, worn, or cracked insulation, or power conductors making contact with other conductors (power or ground). Wires should be supported or bracketed to prevent undue vibration and flexing.

Connections: look for frayed, corroded, loose or broken wires inserted into terminals. Also look for loose terminals and plug connectors. Note: poor connections can sometimes be hidden inside a connector and may not be obvious.

4. Use of Volt/Ohm/Milliammeter (Multimeter).

- The VOM is the only tool allowed to troubleshoot electrical circuits.
- Before conducting any tests, confirm that the bus power source is operating and is within the proper voltage range. If necessary, replace the battery with a fully charged unit.
- When working with direct current (DC) power sources typical in buses, care must be taken to observe polarity when taking measurements. Buses are usually negative ground. The color for negative VOM test lead (prod) is black. The color for positive test lead (prod) is red. Always observe the correct polarity when using the test prods; failure to do so may result in reversed measurement readings. The correct polarity is observed by connecting the red prod of the VOM to the positive (+) side of circuits and the black prod to the negative (-) side.

The VOM can provide the following three measurements. Additional detailed information on conducting the tests is provided later in this practice.

i) Voltage Measurements: Voltage is measured in volts. The testing procedure simply measures volts between two points in a circuit. Use the VOM test prods in parallel (see illustration below; black prod on [-], red prod on [+]) to measure voltage between selected points in a circuit. A circuit must be energized to measure voltage.

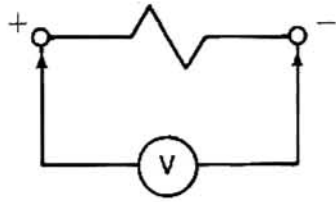


Illustration used with permission from the Thermo King Corporation.

ii) **Current Measurements:** Current is measured in amperes (“amps”), and the test measures the flow of amps in a circuit. Use the clamp-on ammeter (see illustration in “Special Tools” section above) to measure current in a conductor. The circuit must be energized to measure current.

iii) **Resistance Measurements:** Resistance is measured in ohms. Devices such as solenoids, resistors, and wires have specific resistance specifications. With conductors, such as wires, resistance depends on conductor length (longer wires have more resistance), conductor diameter (larger diameter means less resistance), conductor material (some materials conduct better than others), and temperature (resistance varies with temperature change). Tests are conducted to determine circuit restrictions such as opens (“breaks”), shorts, or grounded conditions. The circuit must be de-energized (off) to measure resistance. Use the VOM test prods in series (connected to two ends of the same wire, for example) to measure resistance of a component/wire segment. The component/wire segment must be disconnected and isolated from any other electrical sources.

5. Tests to Determine Defects. General test procedures are as follows.

Voltage Tests

i) **Voltage/No Voltage Test:** Since voltage is “electrical pressure,” it must be present for current to flow and activate a device (e.g., light or relay). To test if voltage is present, energize (turn on) the circuit to be tested. Set the VOM selector to the correct VDC scale (12 or 24 VDC). Observe polarity: Touch the red (+) prod to the power side of the circuit and the black (–) prod to ground. No reading indicates an open in the circuit.

ii) **Available Voltage Test:** This test is used when a known voltage value (e.g., minimum 9 volts) is required to activate a component or system, and the procedure is the same as the Voltage/No Voltage test. Observe polarity. The reading must be within operating specifications for the device (e.g., 11-13 V). Readings over or under specifications indicate defects in power supply or wiring.

iii) **Voltage Loss (Drop) Test:** Whenever resistance occurs in a circuit, voltage is reduced. Some voltage drop is common in every circuit. However, unwanted resistances caused by poor connections, for example, will cause higher than normal voltage drop. A common example is a bad connection of a battery cable at the battery terminal. To make a voltage drop test, the circuit must be energized and under load (i.e., trying to do its job, such as cranking the engine). To use a VOM to check the negative battery cable connection at the

battery terminal, for example, set the VOM selector to appropriate VDC setting and touch the black test lead to the negative battery post, and the red lead to the negative battery cable terminal. Create a load by cranking the engine. If the connection is good, the meter will read near zero volts. A bad connection will read from ½ to 12 volts (in a 12 VDC battery).

The same test can be made to the power side of a circuit. To do so, energize (turn on) the circuit to be tested. Set the VOM to the lowest VDC setting. Warning: do not connect the VOM leads across an energized circuit unless the VOM volt selector is set for the correct voltage range. Touch the red (+) lead to the part of the circuit closest to the current source, usually the battery. Touch the black (–) prod to the terminal of equipment under load. The lower the voltage drop (difference between voltage at rest and voltage when equipment is under load) when under load, the better the connections and wire integrity.

If a high reading is found in either case, place the prods across each wire segment/item of equipment in the circuit to identify the exact defective item or connection.

Current Measurement

i) Current Measurement Test: An ammeter is used to measure the amperes of current flow in a circuit. To test, energize (turn on) the circuit to be tested. Set the VOM selector to the Amp position. Clamp the ammeter around the supply (+) wire and note reading. Compare the reading with device specifications. Low current can indicate a high resistance in the device or wiring. A high reading can indicate a short or short to ground.

Resistance Tests

i) Open Circuit Test: Testing for opens or breaks is also known as a continuity test. Each component has a specific resistance specification. Power must be de-energized before using an ohmmeter. Set the VOM selector to ohms. To test a resistor, for example, touch the prods to each side of the resistor. A reading in ohms above the specification typically indicates an open.

ii) Short/Grounded Circuit Test: De-energize (turn off) the circuit. Set the VOM selector to the ohm setting. Disconnect the load (lamp, motor, unit, etc.) from the circuit. Touch the red (+) prod to the power terminal and the black (–) prod to a known ground. If there is a short circuit, the meter will show a low resistance significantly below the specification. If there is no short circuit, the meter will show normal, at or near the specification level. If there is a grounded circuit (i.e., power terminal coming in contact with bus frame) the meter will read near 0 ohms, which would blow fuses or trip circuit breakers. You may have to isolate sections of the wiring/component in question to identify the location of the short/grounded circuit. It may be wires contacting directly to ground or contacting wires of another circuit. Consult wiring diagrams for possible short circuit paths.

Repairs (Correcting Defects Found during Troubleshooting)

Wires. Note: Repair policy may require replacing a complete wiring harness rather than repairing individual wires. The following method is used to repair individual wires using crimp connectors.

- a) Cut out the defective/damaged wire section.
- b) Select a replacement wire. The wire should be of the same gauge, strand type, insulation type, and insulation color. Cut to length and strip insulation back approximately $\frac{3}{16}$ inch from ends using the wire stripper. Select shrink tubing of correct diameter (slightly larger than wire diameter) and cut to length to cover the splice connector plus a $\frac{1}{2}$ inch on either side. Slide shrink tubing over wire.
- c) Insert the wire into the splice connector for the correct wire gage. Crimp securely using the wire crimper tool.
- d) Slide the shrink tubing over the connector and heat-shrink the tubing by using the heat gun to shrink the tubing tightly onto the connector.
- e) Test the spliced repair by conducting a Voltage Drop Test.

Connections/Terminals.

- a) Cut off the defective connector/terminal.
- b) Select replacement connector/terminal of the same type, wire gauge and connector/terminal size.
- c) Strip insulation back approximately $\frac{3}{16}$ inch. Select shrink tubing of correct diameter and cut to cover connector/terminal and add a $\frac{1}{2}$ inch.
- d) Slide the shrink tubing over the wire. Insert the wire into the connector/terminal. Crimp securely using the wire crimper.
- e) Slide the shrink tubing over the terminal and heat-shrink the tubing by using the heat gun to shrink the tubing tightly onto the terminal.
- f) Test the repair by conducting a Voltage Drop Test.

Devices.

- a) Remove and replace the defective device with a known good device. Test the repair by operating the device.
- b) Devices may be repairable depending on repair policy. Consult manufacturer's manuals and agency policy concerning repair procedures.

SAMPLE MAINTENANCE PRACTICE #5

BRAKES; Remove and Replace Front Brakes; 2003 STARTRANS Senator, 20-Ft.; Ford E-350 Chassis

This sample practice was prepared in cooperation with RADAR, Unified Human Services Transportation Inc., Roanoke, VA, and is based on the Ford Chassis Maintenance Manual and the Haynes Ford Van Maintenance Manual.

Date

February 21, 2005 (Original Issue)

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Objective/Purpose

This maintenance practice provides instructions for the proper removal and replacement of front brake pads on a 2003 STARTRANS 20-foot Senator built by Supreme on a Ford E-350 chassis equipped with a Ford 7.3 L diesel engine.

Glossary of Terms

Brake disc is also called "brake rotor." It's the rotating iron "disc" that the brake pads push against on either side to stop the vehicle.

Caliper is the assembly that houses the brake pistons and pads.

Summary of Local Conditions

Buses are used in Demand Response service.

Inspection and maintenance is accomplished at a new facility that will eventually be equipped with individual mobile wheel lifts.

Parts

Brake pad and anti-rattle clip: P/N 2U2Z-2V001-AG

Pad to piston compound: CRC® - Disc Brake Quiet

Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10)

Special Tools Required

Welders Vice-Grip Pliers—with extended throat width
Torque Stick 140 lb-ft, MAC Tools—Wheel Torque Extension Kit

Safety Precautions and Hazardous Materials

Note: Always replace disc brake pads on both front wheels at the same time—never replace pads on only one wheel.

Always support the bus with jack stands.

The dust created by disc brake pads may be harmful to your health. Never blow it out with compressed air and don't inhale any of the dust. An OSHA-approved filtering mask should be used when working on brakes.

Also wear approved eye and hand protection.

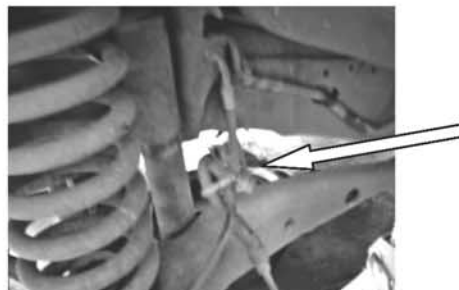
Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts the eyes, flush the eyes with running water for 15 minutes. Get medical attention if irritation persists. If brake fluid is taken internally, drink water and induce vomiting. Get medical attention immediately.

Step-by-Step Procedures

- Step 1 Raise the bus and support it securely on jack stands. Then remove the tire and wheel assembly using an impact wrench.

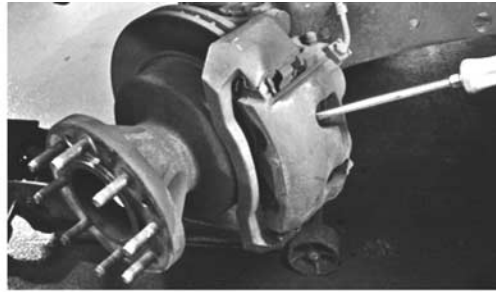


- Step 2 Unclip the speed sensor wiring that is clipped to the front brake hose.

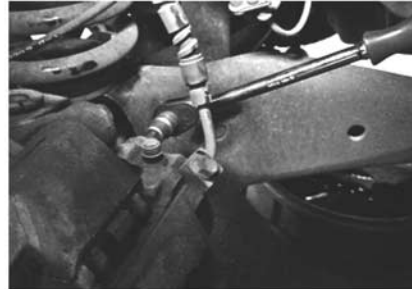


- Step 3 Move the caliper piston back into the bore to provide clearance to remove the caliper from the disc. Pry the caliper away from the disc with a large screwdriver. (See figure on next page.) As the caliper is moved toward you, the disc pushes the two pistons back in their bores. As the pistons are depressed to the bottom of the caliper bore, the fluid will rise in the

master cylinder. Make sure that the fluid does not overflow. If necessary, siphon off some fluid before depressing pistons.



Step 4 Remove caliper mounting bolts



Step 5 Remove brake caliper from the disc and remove the brake pads. Inspect the caliper for torn seals and/or brake fluid leakage. If the caliper is leaking or the boots are torn, the caliper must be rebuilt or replaced.

Caution: Do not allow the disc brake caliper to hang from the front brake hose. The caliper can be supported by the wheel flange or other vehicle part. Use mechanics wire to support the caliper if needed. (See figure at right.)



Step 6 Clean the caliper and sleeve boots with a soft brush (use suitable mask and eye/hand protection). Lubricate the caliper piston sleeve boots. **Caution: To prevent deterioration of the boots, do not use petroleum-based lubricant.** Use Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A (Motorcraft WA-10) or an equivalent silicone compound meeting Ford specification ESE-M1C171-A.



- Step 7 Inspect brake disc carefully. Visually check the disc surface for score marks and other damage. Light scratches and shallow grooves are normal after use and may not be detrimental to brake operation, but deep score marks – over 0.015 inch – require disc removal and refinishing. Check both sides of the disc. If the disc is worn, check the disc thickness. If the disc thickness is less than 28 mm (1.1 in), replace the disc. If pulsating has been noticed during brake application, check disc for runout.



- Step 8 Prepare dual pistons to be depressed back into caliper by inserting an “old” brake pad in place.



- Step 9 Push the piston back into the bore to provide room for the new brake pads. To do this, place the old brake pad against the pistons and press the pistons into the caliper until they bottom out by using extended throat width Welders Vice-Grip pliers. As the piston is depressed to the bottom of the caliper bore, the fluid level in the master cylinder will rise. Make sure it doesn't overflow.



- Step 10 Prepare the new brake pads by applying CRC® **Disc Brake Quiet** (red in color) to the back of the new pads before installing in the caliper bracket.



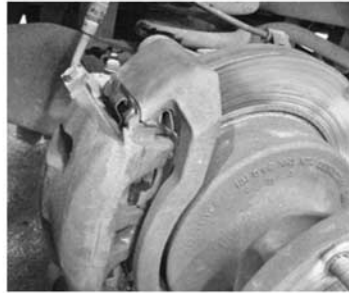
Red “Disc Brake Quiet”

- Step 11 Install the brake pads into the caliper bracket.



New brake pads installed in caliper bracket

- Step 12 Place the caliper assembly onto the brake disc and install the caliper mounting bolts. Tighten the caliper bolts to 16 – 30 lb-ft.



- Step 13 Re-attach the speed sensor wiring.
- Step 14 Firmly depress the brake pedal a few times to bring the pads into contact with the disc.
- Step 15 Reinstall the wheel and torque the lug nuts using Mac Tool Torque Stick 140 lb-ft.
- Step 16 Check the brake fluid level in the fluid reservoir and fill to the proper level if necessary.
- Step 17 Check for fluid leakage and test drive the bus to make sure the brakes operate normally before returning the bus to service. Note: Remember to depress the brake pedal a few times to bring the pads into contact with the disc before moving the bus.

SAMPLE MAINTENANCE PRACTICE #6**Title**

Body; Door Adjustment; Vapor/NFIL Slide Glide Door; 2002 New Flyer 40LF

Agency Name

This sample practice was prepared with assistance provided by the Southeastern Pennsylvania Transportation Authority (SEPTA) and is based on the Maintenance Manual provided by New Flyer Industries Ltd. for Entrance and Exit Doors.

Date

February 1, 2005 (Original Issue)

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Copyright Information

The information contained in this maintenance practice is based on illustrations and information provided by New Flyer Industries, Ltd., for Entrance and Exit Doors as contained in their Maintenance Manual, pages 16-1 to 16-10. Permission to use the copyrighted material was granted by New Flyer Industries, Ltd.

Purpose

This maintenance practice provides instructions for the proper adjustment of front or rear doors on a 2002 low-floor, New Flyer, 40-foot bus equipped with Vapor/NFIL slide glide style doors.

Glossary of Terms

- Slide Glide – door style where both door halves slide inward into the bus, also called In-Swinging Doors. In the open position, the door panels are perpendicular to the side of the bus and as close as possible to the jamb.
- Fore – forward door panel, the half closest to the front of the bus.
- Aft – rear door panel, the half closest to the rear of bus.
- psi – pounds per square inch

Summary of Local Conditions

Not Applicable

Parts

None Required

Special Tools

3-foot carpenter's square; available from Supervisor.

Safety Precautions

- Eye protection must be worn at all times when making door adjustments.
- Pressurized lines should not be disconnected until the pressure is safely and controllably released.
- Any malfunction or deviation of adjustment of the doors or safety systems should receive immediate corrective action.
- No bus shall be allowed to operate in transit service with the door safety systems disconnected.
- Also see specific warnings listed in the step-by-step instructions.

Hazardous Materials

Not Applicable

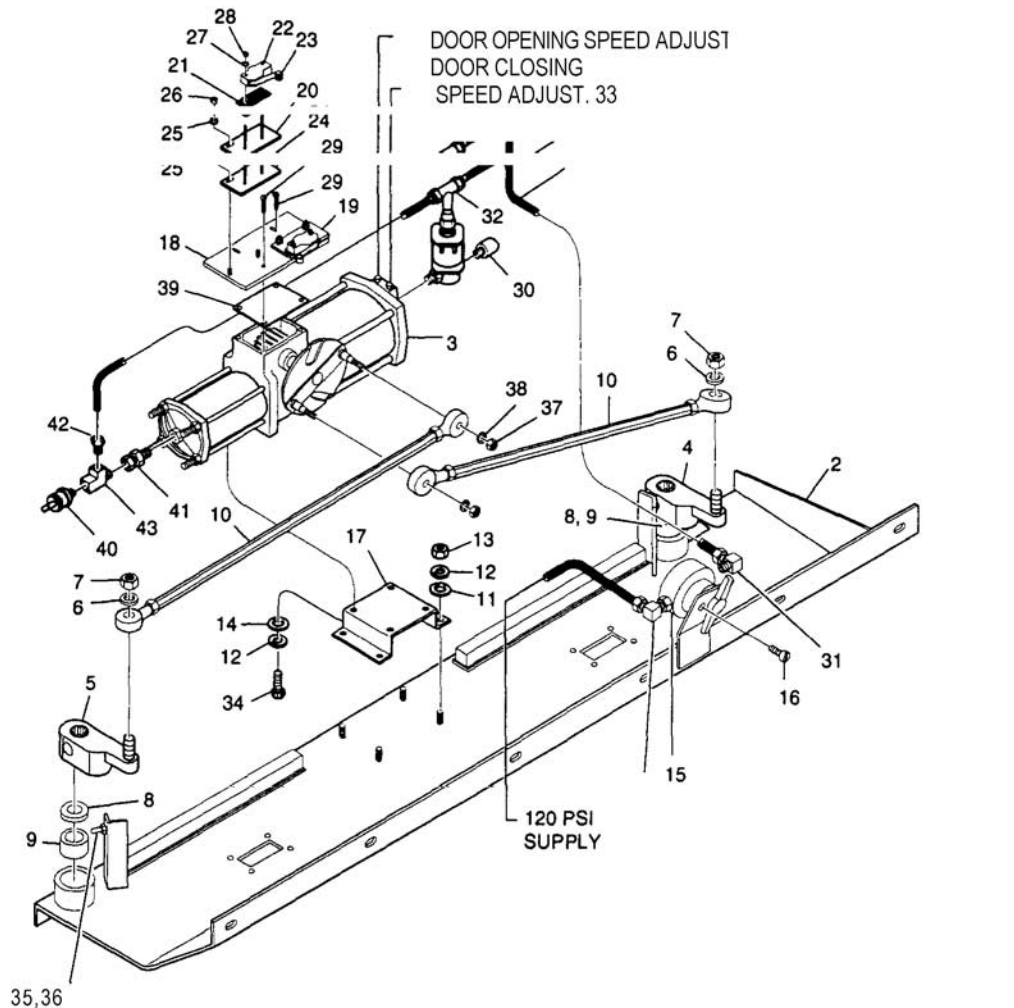
Step-by-Step Process—Door Adjustment Procedure

There are two parts to the door adjustment procedure. Part 1 covers adjustment of door panels and linkages, while Part 2 covers adjustment of door operating speeds.

Part 1

This section covers the adjustment of door panels and linkages.

1. Before attempting to make any adjustments, make sure that the connecting rods have been removed from the door shaft levers (see Figure 1 - Door Base Plate [Entrance]). Each panel can now be moved independently of each other. Also check that all door bracket mounting studs are centered within their respective slots, including the upper roller assembly and lower pivot assembly mounting hardware. This will establish a starting point for all door panel alignment adjustments.
2. Measure the door shaft center to the center distance at the top of the opening. If necessary, adjust the lower pivot in the forward or aft direction to obtain the same door shaft spacing at the bottom of the opening. Use the 3-foot carpenter's square to make sure that the door shafts are square with the bus floor. Tighten mounting hardware to secure the adjustment.
3. Manually close the doors. Check for approximately a $\frac{7}{8}$ " gap between the door trailing edge seal and the jamb seal retainer along the entire door length. If adjustment is required, loosen the four acorn nuts securing the door to the door-mounting brackets and move the panel forward or backward as required. Tighten all mounting hardware after making adjustments.
4. With the doors in the fully closed position, ensure that the top brush forms a tight seal with the top of the doors. If gaps exist, install additional spacers between the door shaft lever and bearing to raise the door enough to form a tight seal. (See items number 4, 5, 8 and 9 of Figure 1).
5. Loosen the door top seal retainer on both door panels and adjust the height of the top rubber seal so that it overlaps the top edge of the doors by approximately $\frac{1}{16}$ " when the doors are in the fully closed position. The top edge of the doors should "wipe" across the seal as they open. Tighten the retaining strip mounting hardware to secure the adjustment.
6. Adjust the door lower brush seals on both door panels by first loosening the 10-32 acorn nuts securing the brush to the lower brush holder. Move the brush down until the bristles fill the step tread grooves. Secure the adjustment by tightening all acorn nuts.
7. Manually push the doors to their full open position. Verify that the doors open to a 90° angle with respect to the step edge. If necessary, loosen the four $\frac{5}{16}$ "-18 roller bracket assembly mounting screws and adjust the roller bracket to obtain a 90° door open position. Tighten screws to secure the adjustment.
8. Reattach the connecting rods to the door shaft levers using the same hardware removed earlier.



- | | | |
|--|----------------------------------|---|
| 1. Base Plate Assembly, Entrance
(Incl. 2...43) | 14. Washer, Plain 3/8" | 30. Silencer |
| 2. Door Base Plate Assembly,
(Welded) | 15. Air Cock Assembly | 31. Elbow, Nylon Tube
Fitting Brass 3/8" |
| 3. Door Operator Assembly | 16. Screw, FH Slotted #8 | 32. Tee, Nylon Tube Fitting Brass 3/8" |
| 4. Lever Assembly, Door Shaft RH
(Incl. 6 & 7) | 17. Plate, Engine Mounting | 33. Tubing, Nylon |
| 5. Lever Assembly, Door Shaft LH
(Incl. 6 & 7) | 18. Switch Plate Assembly | 34. Screw, Locking Torque Patch |
| 6. Washer, Lock Special 5/16" | 19. Plate Assembly, Switch RH | 35. Nut, Hex 5/16" - 18 UNC |
| 7. Nut, Hex 5/16" | 20. Plate Assembly, Switch LH | 36. Screw, Adjustable 5/16" |
| 8. Spacer, Lever | 21. Insulator, Switch | 37. Nut, Hex 5/16" |
| 9. Bearing, Ball | 22. Switch, Snap Action | 38. Washer, Lock Special 5/16" |
| 10. Connecting Rod Assembly | 23. Lever, Switch | 39. Cover, Housing |
| 11. Washer, Plain 3/8" | 24. Screw, PH Slotted #8 | 40. Switch, Pressure |
| 12. Washer, Lock Special 3/8" | 25. Washer, Plain #8 | 41. Connector, Nylon Tube Fitting
Brass 3/8" |
| 13. Nut, Hex 3/8" - 16 UNC | 26. Nut, Hex Keps #4 - 40 UNC | 42. Fitting, Pipe w/Brass Bushing 1/4" |
| | 27. Washer, Plain #4 | 43. Tee, Pipe Fitting Brass 1/4" |
| | 28. Nut, Hex Keps #8 - 32 UNC | |
| | 29. Screw, Hex Flange Locking #8 | |

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Figure 1: Door Base Plate (Entrance)

9. Manually open and close the doors. Verify that the leading panel overlaps the trailing panel during closing. If the edges bind during the closing, lengthen the leading panel connecting rod and shorten the trailing panel connecting rod enough to eliminate the interference.
10. Apply air to the door motor. With the doors in the closed position, verify that the leading door edge metal to metal distance is $4 \frac{1}{8}$ " across the entire door length (see Figure 2 – Door Closure Adjustment). If adjustment is necessary, loosen the $\frac{3}{16}$ ", 16-acorn nuts securing the door panel to the door-mounting brackets and move the panel forward or aft as required. Remove air from the door motor before making adjustment. Tighten mounting hardware to secure the adjustment.
11. With the doors in the closed position and air applied to the door motor, check the door-closed preload. The doors should sit firmly against the jamb seals and should not exhibit any looseness or play. To increase the door-closed preload, loosen the connecting rod jam nuts and shorten the connecting rod lengths as required. If a preload adjustment is made, recheck the door panel phasing. Refer to Step 9. Tighten connecting rod jam nuts to secure the adjustment.
12. Power open the doors and check door-open preload. In the fully open position, the doors should not exhibit any looseness or play. To increase the door-open preload, loosen the connecting rod jam nuts and lengthen the connecting rod lengths as required. If a preload adjustment is made, recheck the door panel phasing. Refer to Step 9. Tighten connecting rod jam nuts to secure the adjustment.
13. With the doors closed, turn the door shaft lever stop adjustment screws on the baseplate counter-clockwise until the heads make contact with the door shaft levers. Secure the adjustment of the stop screws by tightening the stop screw jam nuts.

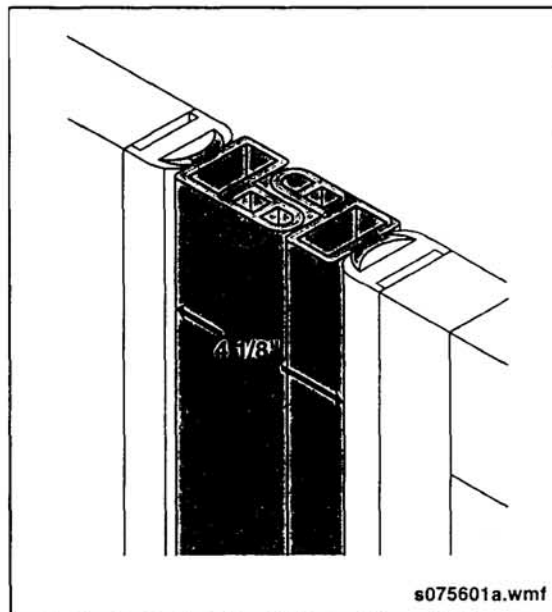


Figure 2 – Door Closure Adjustment

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Part 2

This section covers the adjustment of door operating speeds.

NOTE: *Never force adjusting screws when adjusting them in a clockwise direction. Excessive tightening pressure (metal to metal) will damage the motor cylinder cap.*

1. Verify that all piping and wiring are properly secured and clear of all moving parts. Check to make sure that none of the wiring or piping is making contact with sharp metal surfaces or edges that may cause fraying or chafing.

NOTE: *Initially the closing speed adjustment screw is set 0.25" +/- 0.03" above the top of the lock nut, and the opening speed adjustment screw is set 0.31" +/- 0.003" above the top of the lock nut. When making adjustments always adjust the closing speed first since this adjustment also affects the door opening speed. When making adjustments to the speed of the door operation, ensure that the vehicle is connected to a constant source of air supply (shop air).*

2. To adjust the door closing speed:
 - a) Loosen the jam nut that secures the closing speed adjusting screw (see Figure 1). Turn the screw counter-clockwise to increase the speed or clockwise to decrease the speed.
 - b) While holding the adjustment screw, tighten the jam nut to secure adjustment.

WARNING: Closing speed should be adjusted to ensure 1.5 to 3.0 seconds of time between initiation of closure and full door closed position. Door closing speed must fall between 2.5 and 5.0 seconds during all pressure possibilities between 120 and 95 psi. If the door is adjusted at the highest normal pressure, the speed will decrease when lower pressure is available.

3. The door opening speed should also be between 1.5 and 3.0 seconds. To adjust the door opening speed, loosen the jam nut that secures the opening speed adjustment screw (see Figure 1). Turn the screw counter-clockwise to increase the speed or clockwise to decrease the speed. Tighten the jam nut after adjusting.
4. To adjust the cushioning during the opening cycle, loosen the jam nut that secures the door opening speed adjustment screw and turn the screw clockwise for more cushioning and counter-clockwise for less cushioning. After adjusting the cushion, tighten the jam nut and recheck the opening speed.

SAMPLE MAINTENANCE PRACTICE #7

Title of Practice

Service; Service Line Functions

Agency Name

This sample practice was prepared in cooperation with Lynx, Orlando, FL

Date

February 11, 2005

Version

Version #1 (Original Issue)

Web Board Disclaimer

The following disclaimer is used when this practice is posted on the TRB Maintenance Practices Web Board; remove for internal agency use:

The information contained in the published content is provided as a service to the bus transit community, and does not constitute advice. Every attempt was made to provide quality information for the purposes outlined for this project, but we make no claims, promises, or guarantees about the accuracy, completeness, or adequacy of the content. Maintenance advice must be tailored to the specific circumstances of each agency. Because bus maintenance practices can change without notice, nothing provided herein should be used as a substitute for the advice of competent mechanics and/or maintenance crews.

Objective/Purpose

The objective of this maintenance practice is to define the job descriptions and duties for Service Line personnel to ensure that their activities are conducted in an orderly, thorough, and productive manner. There are seven Service Line positions:

- Driver
- Fueler
- Streetside Washer
- Curbside Washer
- Interior Cleaner
- Window Cleaner
- Detail Cleaner

Except for the Driver, Service Line personnel are allowed to exchange jobs up to two times per week.

Glossary of Terms

- A/C: air conditioning system
- Speedy dry: oil-absorbent granules used to soak up oil spots and spills
- Dry break: fuel system that allows fuel filler to be connected and disconnected without spilling fuel

Summary of Local Conditions

- The agency is absolutely committed to providing extremely clean buses to the public as a way of earning the public's respect and patronage.
- The agency policy is to remove any graffiti and gum on a daily basis.
- Bus wheels are powder-coated with brilliant white paint. The Service Line is used to keep the wheels looking freshly painted.
- Water in the region is extremely "hard," which requires the use of chemical rinsing agents and special attention to keeping windows spot free.
- Thorough cleaning is scheduled for each bus once a month.
- Buses are parked outside. Parking is extremely limited, with bus lanes only 10 feet wide. Due to the unique conditions, all buses must be backed into the lanes after daily servicing. The special driving challenges require a dedicated driver position with no other Service Line duties.
- Fareboxes are vaulted before they enter the Service Line, so this function is not part of the Service Line.

Special Tools

- Small broom
- Large broom
- Mop and bucket
- Work cart with cleaning supplies, including scraper, pine soap for mopping, graffiti remover, counter brush to clean A/C return grill, and cleaning rags.

Safety Precautions/Applicable Regulations

- All Service Line attendants are required to have a valid commercial driver's license (CDL) and must carry it with them at all times while on duty.
- Service Line attendants are provided with the following safety equipment and are urged to use them when performing their duties:
 - One box of 100 rubber gloves each month
 - Safety "bump" cap

- Raincoat with reflective material
- Safety goggles and rubber gloves must be worn when using spray-on freezing agent to remove gum.
- Safety glasses and rubber gloves are required while checking coolant.
- Any speedy dry used to absorb large oil spots/spills must be disposed of in special containers used to store and dispose of this hazardous material.

Step-by-Step Procedures

Driver

- 1 Drive bus from parking area to pre-wash area of the Service Line. Note: the speed limit within the facility is 10 mph. Turn off A/C, but keep engine running. Open exit door.
- 2 Drive bus that has already been pre-washed to the fuel island ahead. Turn off the fast idle, place transmission in neutral, apply parking brake, and leave engine running. If the bus ahead has already been moved to the fuel island by a bus washer, go to step 3.
- 3 Drive a bus that has already been fueled through the bus washer; make sure windows and roof hatches are closed and turn on windshield wipers. Note: the speed limit through the bus washer is 2 mph. Report any bus washing problems immediately to the Supervisor.
- 4 Return the washed bus to the parking area. All buses must be backed into the parking space. Leave the bus running; make sure the transmission is in neutral and apply the parking brake. Turn on the interior lights and hazard flashers.
- 5 Retrieve another bus from the parking area and continue the process of moving buses through various stages of the service line and back to the parking area. Complete the bus service log and return the form to Supervisor at the end of the work shift.

Curbside Washer (Pre-Wash Area)

- 1 Wash the front and rear wheels and hubs with brushes and grease remover.
- 2 Wash the side mirror, lower body panels, and front and rear doors.
- 3 Rinse out the exit stepwell; be careful not to get water inside the bus.
- 4 Open the fuel door.
- 5 Go inside the bus to the driver's area and remove large debris, such as transfers, napkins, and newspapers. Move the driver's seat full forward and backward while checking for debris.
- 6 Lift up handicap seating and remove any debris.
- 7 Remove large debris from window ledges and seats.
- 8 Make sure that windows and hatches are closed and secured. Add garbage bags if needed. Make sure the fast idle switch is off.

Streetside Washer (Pre-Wash Area)

- 1 Wash the front and rear wheels and hubs with brushes and grease remover.
- 2 Wash the driver's window and mirror, the lower body panels, and the entire rear panel up to the muffler.
- 3 Wash the back end of the bus and open the rear engine bay door.
- 4 Assist the curbside washer with interior cleaning as needed (see steps 5-8 above).
- 5 If a Driver is not available, move the bus forward to the fueling area to keep the line moving. After moving the bus, place transmission in neutral, apply the parking brake, and keep the engine running.

Fueler (Fuel Island)

- 1 Before fueling the bus at the fuel island, wash the front end of the bus behind you in the pre-wash area.
- 2 For the bus that you will fuel, record the bus number, the date, and your employee number on the fueling report form.
- 3 Connect the fuel hose and begin to fuel.
- 4 Open the engine compartment door and switch on the engine compartment lights if needed.
- 5 Check the transmission fluid level while the engine is still running at idle speed and the transmission is in neutral. Use the "hot run" section of the dipstick to read the level, which is full when the reading is at the halfway point between "low" and "high." If reading is at the "low" mark, add 2 quarts. Do not overfill.
- 6 Turn the engine off and check the engine oil level. Add oil if needed according to procedures described below for each engine. Note: When adding oil, add less than you feel is necessary and check again after 15 seconds.

Series 50 Detroit Diesel:

The oil level should be at the "low" mark of the "off" area. Just below the "e" of the word "idle" indicates oil level is 4 quarts low. See picture for details.

Cummins M-11:

The oil level is full when the reading is at the bottom of the "safe" range. If the level is down to the "a" of the "add" mark, the engine is 2 quarts low. See picture for details.

Cummins ISL:

The oil level is full when the reading is at the middle of the safe area. If the reading is at the bottom of the safe area, add 2 quarts. See picture for details.

- 7 Check for any fluid leaks, worn or broken drive belts, loose starter motors, and other defects in the engine compartment. Report any defects on the fueling report form.
- 8 Check the coolant level while the engine is off. Note: safety glasses and rubber gloves are required while checking the coolant. Open the surge tank door and press in the surge tank pressure relief button until all pressure is relieved. Stand aside and open the surge tank cap

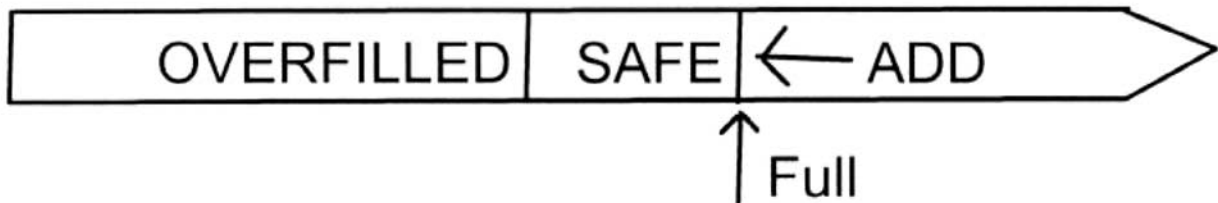
to the safety-catch position. Press in the safety catch to fully open the surge tank cap. Visually check the coolant level, and add coolant as necessary. Look for any contamination in the coolant, such as fuel and oil, by noting color. Report any defects on the fueling report form. Close the surge tank cap and make sure it locks. Ensure that the pressure relief valve is pulled out.

- 9 Start the engine and listen for loud pulley bearing noises or other unusual sounds. Report any defects on the fueling report form. Switch off the compartment lights if activated and close the engine door.
- 10 Remove the fueling nozzle and close the fuel filler door.
- 11 Record the fuel and any fluids added to the vehicle on the fueling report form.
- 12 Immediately report to the Supervisor any engine or transmission needing 4 quarts or more of oil. Also report immediately any bus that leaks fuel from the dry-break nozzle during the fueling operation.
- 13 Turn off the engine compartment lights and close the engine bay door.
- 14 At the end of the shift, clean the fuel stand, fuel hoses, and oil barrels. Use oil dry granules (speedy dry) to clean up any large oil spots or spills. When doing so, be sure to dispose of the speedy dry in the special container used to contain this hazardous waste. Clean the fuel lane driveway with the special formula spray, and hose down the fuel lanes with water.

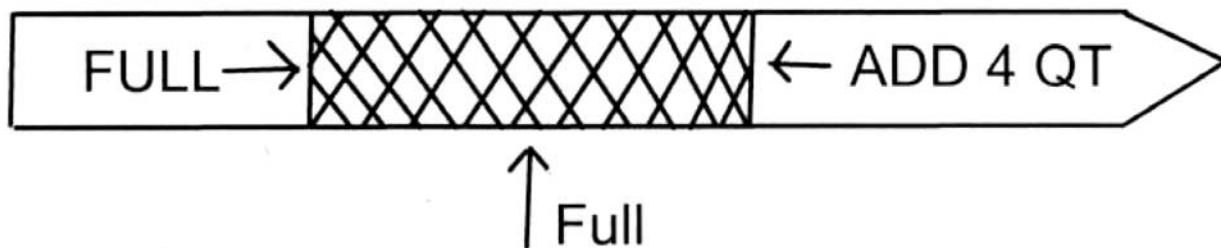
Series 50 Detroit Diesel



Cummins M-11



Cummins ISL



Interior Cleaner (Parking Lot Area)

- 1 Sweep behind the driver's seat. Remove any debris and clean under the seat.
- 2 Sweep the rest of the bus thoroughly, making sure to remove all debris under and between the seats. Ensure that the rear wheel wells are completely clean on each side, sweeping out any debris. Use the small broom under the seats and the large broom down the main walkway.

- 3 Wipe the dash, driver's gauges, and driver's sun visor.
- 4 Mop the bus floor thoroughly and scrub out any stains. Clean the steel runners on both sides of the floor. Mop thoroughly behind each wheel well and along the surface of the lower panel just below the seats in the very back of the bus.
- 5 Mop the entire driver area floor.
- 6 Clean and mop the flooring ledge at the rear of the entrance step well.
- 7 Remove any graffiti and gum.
- 8 After mopping 6 to 7 buses, clean the mop and change the water.
- 9 When the shift is over, clean the cart, return all tools, empty the trash bag, and clean and rinse the mop and mop bucket. Wet mops are stored with mop head up to facilitate drying. Fill out the "Mopped Bus List" and give it to the Supervisor.

Additional Duties: Monday, Wednesday and Friday

- 1 Clean window frames and panels between and above each window. Clean each interior mirror used by the driver; remember there is one located by the back door. Clean window ledges and the front wheel well area on both sides of the bus.
- 2 Clean handrails, TV monitors and the farebox.

Additional Duties: Tuesday and Thursday

- 1 Clean the entrance doors, including grab rails and stepwell lights.
- 2 Clean the air conditioning (A/C) return air grill, the exit stepwell corner molding, and the exit doors.

Window Cleaner (Parking Lot Area)

- 1 Clean all bus windows on 25 buses per work shift, including all mirrors.
- 2 Keep a log of buses completed on each shift.

Detail Cleaner (Parking Lot Area)

Lights and Panels

Thoroughly clean the following:

- 1 Light covers for the interior lights. Remove signs from the sign panel and clean both sides of the sign and panel.
- 2 Speaker panels, A/C return air grill, ceiling panels, roof hatches, and rear wall, including the area below rear seats.
- 3 Melamine panels from above the windows to the bottom of the seat edge.
- 4 TV monitors front and back.
- 5 Front and rear doors, including grab rails and modesty panels.
- 6 Window moldings on each window.

Driver Area

Thoroughly clean the following:

- 1 Top header of the front door, including the mirror above it.
- 2 Area just below the ceiling line to the top of the windshield, including the mirror.
- 3 Driver's barrier, front and back, as well as the floor area behind the driver's seat.
- 4 Area around the driver's pedals.
- 5 Entire farebox.

Seating Area

Thoroughly clean the following:

- 1 All seats, including backs and undersides. Remove seat cushions to clean seat bottoms and any debris caught between the seats.
- 2 Lower wall from the seat edge to the floor.
- 3 Steel runners along the edge of the floors and wall.
- 4 All handrails.

Floor

Thoroughly clean the following:

- 1 The floor, including the step area, by removing all gum and scrubbing with stiff brush. Also brush the standee line and the lines in each stepwell.
- 2 Front and rear wheelwells.

Note: Blue and red floors cannot be cleaned with the Formula 50[®] cleaner! It can only be used on cream-colored and flat floors.

Back and Front Steps

Thoroughly clean the following:

- 1 Stainless steel portion of each stepwell.
- 2 All black molding around the tops of steps.
- 3 Stepwell safety lights.
- 4 Handrails at each stair well.

Windows

- 1 Clean all windows inside the bus.

Clean and return all cleaning equipment at the end of the work shift.